



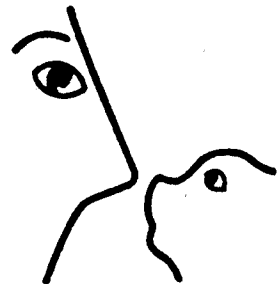
ISAZ 2000

*AMSTERDAM,
THE
NETHERLANDS*

ISSUES IN COMPANION ANIMAL

WELFARE

25th April 2000



**MULTIDISCIPLINARY
RESEARCH INSTITUTE**
on the relation between
HUMANS AND ANIMALS



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INTRODUCTION

Companion animals have become increasingly popular over the past few decades. Since the 1960s, the study of human–animal interactions and relationships, now commonly known as anthrozoology, has flourished. Initially, much of the early research was human-centred, focusing on how pets might benefit human health and well-being. However, in the last few years concern for the welfare of our animal companions has grown significantly. ISAZ recognises the importance of this topic and it is for this reason that we chose the theme “*Issues in Companion Animal Welfare*” for our annual conference this year. The speakers and topics for our meeting are testament to the significance of this area of study, and we believe they will encourage lively and informative discussions.

ISAZ 2000 is part of the pre-conference programme for the WSAVA/FECAVA Congress for small animal veterinary surgeons. This is an excellent opportunity for ISAZ to present itself to a broad and international audience, and we trust that this will foster useful links between the Society and the veterinary profession.

We look forward to meeting you all. Let’s have a gay ol’ time!

Nienke Endenburg, PhD

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Dogmatism and Catechisms--Ethics and Companion Animals

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It is easy to see that new ethical concern for animal treatment has arisen all across the western world in the areas of research, testing, agriculture and wildlife. However, little attention has focussed on companion animals. Yet there are major abuses in this area which violate the fundamental purpose for which we keep such animals. The few old clinched solutions have not worked. It is therefore necessary to encode rules for the treatment of companion animals into our social ethic. This must be accompanied by meaningful education.

AT THE SHARP END: THE EVERYDAY EXPERIENCE OF ANIMAL WELFARE ISSUES WITHIN AN ANIMAL AMBULANCE SERVICE
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Existing research on animal welfare has clearly drawn attention to the kind of problems and abuses that pet animals routinely face as a consequence of living within human society. In recent years, perhaps due in part to our growing sensibilities towards other creatures and the increased public and media fascination with animal and veterinary matters, we have become progressively more aware of the physical, mental and nutritional requirements of the pet animal species with which we share our lives. Our increasing awareness of the need to preserve and protect the welfare, rights and integrity of animals has also led to the establishment of a multitude of charitable organisations to deal with animal welfare issues. It is from within such organisations that the problems associated with animal welfare are experienced on an everyday basis and hands-on fashion.

In the Netherlands, for example, a unique nation-wide network of volunteer animal ambulances exists to serve the needs of pet, stray and wild animals in crisis situations. Ambulance personnel are routinely confronted with the full spectrum of human-pet animal relations, ranging from deep affection to sadistic cruelty to the animals. Within the space of a few hours, for example, they may encounter individuals who are prepared to spend vast sums of money to preserve their pet's health and then have to fish the cadavers of dogs out of canals that have died at the brutal hands of their masters. Fortunately, extreme instances of maltreatment are rare. Most of the animal welfare problems that ambulance volunteers will encounter are instead the unfortunate consequence of accidents and ignorance, rather than deliberate neglect or overt cruelty.

This paper draws upon ethnographic data collected overtly whilst working part-time as a volunteer on the Amsterdam Animal Ambulance service for a period of 1½ years. It will focus upon the ambulance workers' everyday experience of animal welfare issues, especially their responses to situations where animal health and welfare appears to be being compromised by pet owners, members of the public, animal shelters and, perhaps surprisingly, even veterinarians. Particular attention will be devoted to how the ambulance workers' individual conscience and desire to protect animal welfare is at times in apparent conflict with their clearly defined role and responsibilities. The ambulance's task is essentially to transport sick, injured, deceased and problem animals (both stray and owned) from A to B, with the additional administration of first aid or other life saving measures if necessary. Some personnel, however, believe that their responsibilities to the animal and its welfare should extend much further. This paper will thus discuss the feelings of powerlessness and frustration sometimes experienced by ambulance volunteers and the conflicts that can occur between colleagues, ambulance management and other parties, such as owners and veterinarians, as a consequence.

STUDYING ANIMAL-RELATED ATTITUDES OVER THE INTERNET

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The Internet offers a new venue for researchers interested in studying human/animal interactions. We developed a World Wide site to investigate differences in ethical judgements of animal research among members of three groups: animal rights activists, animal researchers, and respondents who were neither animal rights activists nor animal researchers.

Subjects: Participants were recruited via the Internet. We announced the site over a variety of animal research and animal rights e-mail discussion groups. A total of 1442 Internet submissions were received. However, to preclude multiple responses from single individuals, we only included a single submission from any one computer IP address. We also excluded incomplete surveys. The final sample consisted of 228 individuals involved in animal organizations ("animal rights group"), 168 people who worked in animal research labs or were members of animal research defense groups ("animal research group"), and 505 participants not involved in either animal rights or animal research defense groups ("non-aligned group").

Materials: The Internet survey consisted of several parts. The Animal Attitude Scale (AAS) is a previously designed measure of general attitudes toward animal welfare issues. The Animal Research Justification Scale (ARJS) was designed for this study. It consisted of 27 items in which subjects were asked to rate how justified a series of research projects were. The projects varied in type of illness (terminal, chronic non-lethal, psychological) and in the species used in the research (monkeys, rats, pigs). The projects were rated on a 1 (completely unjustified) to 4 (completely justified) scale.

Results: There were significant differences between the three groups of subjects on both AAS scores ($F = 272.05, p < .001$) and the ARJS scores ($F = 273.25, p < .001$). There were also significant gender differences. Female subjects had significantly higher scores than males on the AAS ($t = 12.52, p < .001$) and significantly lower scores on the ARJS ($t = 10.226, p < .001$). Sixty-four percent of the animal rights group were women as opposed to 46% of the researcher group ($\text{Chi square} = 11.59, p < .05$). The three participant groups differed in their degree of justification for the research projects. The justification scores of the activists were not significantly affected by species. There was, however, a significant difference in this group in the degree of justification of different types of research. (Research projects aimed at developing treatments for lethal conditions were viewed as more justified than research directed at chronic or psychological disorders.) In both the non-aligned group and the animal research group, there were significant main effects of both species and type of research. Research with rats and pigs was perceived as more justified than research with monkeys. Research aimed at developing treatments for chronic, non-lethal diseases was seen as less justified than research aimed at treatments for psychological and terminal illnesses. The promise and perils of the attitude research over the Internet will be discussed.

COMPREHENSION OF HUMAN COMMUNICATIVE SIGNS IN PET DOGS

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In their study, Povinelli et al. (1999) tested, whether juvenile chimpanzees and three-year-old children would consider the human gaze as a mental state of attention. Their results showed that chimpanzees did not understand the significance of seeing as a mental state.

Eight female and six male dogs of various breeds aged between 10 months and 12 years, took part the experiment. The dog-owner pairs recruited from participants of our Family Dog Research Program.

In this experiment, the dogs' task was to find a food pellet on the basis of signals given by the experimenter. The food reward might be in one of two plastic pots: one was on the right side of the experimenter, and one on the left. The experiment consisted of three phases: pretraining, pointing trials, test trials. During pretraining the experimenter made the dog to understand that one of the two pots might contain food. In pointing trials the experimenter baited the food pellet such a way, that the dog could not see the procedure and indicated the place of the reward by pointing briefly to the baited pot. The dog was allowed to choose only one pot. The training was continued until the dog had reached the learning criterion (90% of correct choice in two subsequent sessions). Test sessions consisted of 12 trials: four probe trials were embedded into pointing trials. 3 types of probe trials were used. 'At target': the experimenter orienting her entire head and eye gaze toward the correct pot. 'Above target': the experimenter orienting her head and body in the same fashion as on the 'at target' trials but looking above the baited pot to the upper corner of the room. 'Eyes only': the experimenter facing the dog and turning her eye gaze toward the correct pot. There were six sessions for each dog, with eight probe trials for each type of cue. The presentation of cues was balanced for right and left side.

During the test procedure, dogs performed significantly above chance on 'at target' treatment ($\chi^2 = 18.25$, $p < .0001$), but randomly on 'above target' and 'eyes only' treatments. The comparisons of the I.-III. sessions with the IV.-VI. sessions showed that in 'at target' treatments, dogs' rate of correct choices were in high level from the very start of the experiment ($z = -1.54$, $p = .1235$). In the case of 'above target' trials, the performance of dogs was at chance level in both the first and the last three sessions of the experiment ($z = -.63$, $p = .529$). Regarding the signals given by gazing ('eyes only'), the reaction of dogs was changed considerably. During the first part of the experiment they performed below chance-level, but in the second three sessions this level was increased to chance level or above ($z = -2.49$, $p = .0125$).

It is probable, that each dog - living in a human family - had some previous experience about the head-nodding movement. The dogs did not consider the head-turning of the experimenter as a sign referring to the place of the food. In the case of gazing trials, it seems that at first the dogs avoided the baited pot, to which the owner gazed, but within a short time they learned to prefer it. Our results suggests, that the dog' sensitiveness to human communicative signals is comparable to human infants and they are more ready to interpret human communicative acts than juvenile chimpanzees.

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BENEFITS, PROBLEMS, AND CHARACTERISTICS OF HOME AQUARIUM OWNERS

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Aquarium fish in homes are currently the most popular "pets" in the United States. Little is known concerning any benefits or problems associated with these fish, including those that could impact welfare; the characteristics of the owners of such pets also are not well-studied. To learn more about the people who own and care for home aquaria and whether they provide their "pets" the same or similar considerations for animal welfare they allow terrestrial pets, 50 men and 50 women were interviewed in several area stores which provide and sell living fish and adjunct products necessary for maintaining good environments in home aquaria and welfare advantages.

Respondents had an average of 10 fish, and over half of the subjects owned only fish, with no other companion animals. In contrast with keeping dogs or cats, the average age for first owning fish was 21 years. Women owned only freshwater or saltwater fish, whereas 12% of the men kept both types of aquaria, and a larger proportion of men than women owned saltwater fish. In comparison with fresh water aquaria, keeping saltwater aquaria was more expensive, required more time, used more specialized machinery, and involved more knowledge of water chemistry. Among problems reported by owners of home aquaria were purchasing the expensive equipment, including the tanks and controls for water temperature, circulation, and chemical balances, maintaining the tank and keeping the tank clean. Poorly maintained aquaria sometimes resulted in adverse living conditions for fish that resulted in their premature deaths. Major benefits mentioned by these owners were the calming, relaxing, and stress-reducing effects of just watching fish. Owners reported that looking at the fish lessened their anxieties and created a sense of serenity.

Although these findings help to explain the current popularity of the live inhabitants of home aquaria, the subjects skirted such welfare issues as the amount and kind of intimate interactions they have with their fish, their problems in coping with the short life spans of fish and the emotional costs to them of the deaths of their favorite fish, and their feelings about how well or how indifferently fish are cared for in comparison to the more familiar terrestrial and avian pets. As with other companion animals, keeping of fish aquaria requires learning how to provide appropriate care and takes a significant commitment of time and resources. Lacking optimal care, aquarium fish can quickly become subject to poor welfare conditions that impact their well-being.

Oral presentation

OBSERVATIONAL LEARNING OF A BEHAVIOUR PATTERN OF THE OWNER BY PET DOGS

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By definition, observational learning has occurred if an animal that has viewed an experienced 'demonstrator' learns the response in question more rapidly than one that has had no previous observational experience (Davey, 1981). Davey (1981) considers observational learning to be a means of facilitating social cohesiveness by maintaining a group 'identity' and as a vehicle for communicating useful information between conspecifics.

Although observational learning has been demonstrated in a wide variety of animals, similar investigations on domestic dogs are rare. The object of this study was to determine whether pet dogs, raised in human families can acquire a behaviour pattern of the owner. Dogs live in our society for more than 100,000 years (Vilá et al.) It might be argued that this long common history of dogs and humans enhanced the dogs ability of observational learning and social facilitation.

Our experiment was a modified version of the study used for social learning in pigeons (Palameta and Lefebvre 1985).

Experimentally naive adult pet dogs were exposed to varying amounts of socially transmitted information needed for solving a ball-finding problem (N=44). The ball was hidden in a closed box (30x15x50 cm), and could be obtained by manipulating a lever attached to the box. Observer dogs (N=16) that saw the owner perform this movement 10 times were able to solve the problem faster and more efficiently than dogs that only saw the owner playing with a ball but not obtaining it (N=14). Dogs who saw the owner performing the special movement 10 times but not obtaining the ball (N=16) were slower in acquiring the ball, but more precise in the way of acquisition.

These results suggest two important conclusions. On one hand, dogs are capable of learning the way of ball-getting technique by observation rather than by trial and error. On the other hand copying behaviour was not only depend on the fact, that the observer recognized during the observations the possibility of getting reward (a ball). Those dogs who saw the demonstration without reward were able to get the ball significantly later, but at the same time their action was a more precise copy of the owner's demonstration.

Our results demonstrates that most dogs have an ability for copying the behaviour of the owner in spite of that they do not recognize the exact goal of the action. These results are similar to that of found in apes (e.g. Hayes and Hayes, 1952), and therefore we may suppose that the cognitive capacities of the dog in copying an action are comparable to ape's.

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CHILDREN AND ANIMALS AS VICTIMS AND HEALERS: ANIMAL ABUSE AND HUMAN VIOLENCE

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Amsterdam 25.04.2000

Over the past 100 years, dedicated humane educators have tried to develop children's positive relations with animals. When these efforts succeed, the welfare of animals is enhanced and, many believe, human welfare is promoted.

But humane educators are not the only teachers of children. Children learn lessons about the roles of animals in society from a variety of sources: parents, siblings, peers in their neighborhoods and schools, other adults, and the diverse forms of media to which children are exposed in late-twentieth century society.

I will address the recent phenomenon where animal welfare and human welfare professionals become allies in confronting the problem of violence in society.

Inhumane Education. If humane education is teaching children to be kind and compassionate toward animals, inhumane education is teaching children to abuse and neglect animals. The lessons may sometimes be deliberate, for example, when a parent tells a child to watch as a dog is "disciplined" by beating it with a belt buckle. But more often the lessons are unspoken and learned by observation. That these lessons are effective often surfaces when children present evidence of their psychological distress.

In developing this theme, I will briefly review our current knowledge about factors related to animal abuse. These factors include children's experiences with physical and sexual abuse, their exposure to domestic violence, and animal abuse as a form of psychological or emotional abuse of humans. There is now a substantial literature demonstrating the association between early childhood and adolescent histories of animal abuse and later antisocial and violent behavior (Lockwood and Ascione [Eds.], 1998, *Cruelty to Animals and Interpersonal Violence: Readings in Research and Application*. Purdue University Press; Ascione and Arkow (Eds.), 1999, *Child Abuse, Domestic Violence, and Animal Abuse: Linking the*



Circles of Compassion for Prevention and Intervention, Purdue University Press).

I describe the results of research with over 100 women who were battered by their partners and a comparison group of women reporting no domestic violence. This research demonstrates that a) companion animal ownership is common even in families where there is domestic violence, b) companion animals are often threatened, abused, and sometimes killed in families experiencing domestic violence, c) children frequently witness the abuse of companion animals, and d) concern for their pets' welfare prevents a substantial proportion of abused women from seeking shelter sooner than they did. I will also describe efforts being made to protect pets residing in violent homes (Ascione [2000], *Safe Havens for Pet: Guidelines for Programs Sheltering Pets for Women who are Battered*) and therapeutic efforts, facilitated by dog training, to heal the psychological wounds children endure when they grow up as victims of abuse and neglect.

These results and those of other investigators have prompted the development of collaborative programs between animal welfare and domestic violence professionals. The primary purpose of these programs is the sheltering of companion animals for women and children fleeing violent homes. The programs represent a new and significant type of cooperation between individuals dedicated to animal and to human welfare. Implementing such programs also presents challenges for the fields of animal welfare, child welfare, and domestic violence intervention. These challenges will be discussed in the context of program evaluation needs.

It is clear that the next century will be an opportune time for developing the confluence of animal welfare and human welfare programs. As the "gap" between the souls of people and animals narrows, we will see more clearly how holding nonhuman animals in higher regard can also benefit the human condition.

ATTACHMENT FORMING ABILITY OF ADULT DOGS LIVING IN RESCUE CENTERS

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Infantile attachment and the ability to form social bonds to different objects in variable environment have already been studied on many species. As this ability is usually associated with infancy, there are several theories and models of the development of attachments in infants. However, thorough research of attachment behavior beyond the infancy period has been done only on humans.

A slightly modified version of the Strange Situation Test, that was originally designed for assessing human infant-parent attachment (Ainsworth & Wittig, 1969) proved to be a useful method for activating and studying the dog's attachment behavior towards humans, thus investigating the social bond between dog and owner (Topál et al., 1998). These studies showed that the dog's relationship to humans is analogous to the child-parent attachment behavior.

In our experiment 60 dogs living at rescue centers were observed in the modified version of SST. 40 of them were handled for 10 minutes on three consecutive days before testing. The handling was carried out on leash and consisted of talking to the dog, petting, making very simple exercises such as making them sit down, walking together or playing depending on the willingness of the dog. The function of the handling was to form roles, i.e. to make "owner" from the handler person. In the handled group the handler of the dog acted as the "owner" and an unfamiliar experimenter acted as the "stranger" in the test situation. In the tests of the non-handled group both the "owner" and the stranger were unfamiliar to the dogs. The behavior patterns of the dogs towards the "owner" and a stranger were compared and analyzed in the handled group and in the non-handled group as well.

- * The results demonstrate that the dogs of the handled group showed patterns of attachment behavior towards the handler, i.e. preference for the "owner" compared to the stranger: these dogs showed higher level of contact seeking towards the entering "owner" in the reunion episodes than towards the entering stranger ($Z=-3.453$, $p<0.001$). Discriminative responses during separation were also observed: dogs from the handled group spent more time standing by the door in presence of the stranger than in those episodes when the "owner" was present ($t/38=-5.2$, $p<0.0001$). These patterns of attachment behavior were not found in the non-handled group.

Our study supported our hypothesis predicting that adult dogs living in rescue centers show increased demand for social contact with humans, and due to the extreme separation this genetically determined demand can result in rather fast forming of attachment.

Title: THE EFFECT OF ENRICHED HOUSING ON ADOPTION SUCCESS OF SHELTER CATS.

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Adult shelter cats have historically experienced low adoption and high euthanasia rates. The "No-kill" sheltering trend, while reducing the euthanasia rate, has done little to increase adoptions. Hence, long term confinement of adult cats in shelters is becoming a significant problem. This study examined the effect of four levels of social and environmental enrichment in the shelter, on the adoption success of cats.

A total of 165 adult and elderly cats, either relinquished or classified as adoptable strays, were assigned to one of four type of housing. "Single non-enriched" consisted of stainless steel cages measuring 51cm x 51cm x 69cm containing a food and water bowl, a litterbox and a towel as bedding material. "Single enriched" were similar, but with various toys and a wooden resting shelf covered with a towel. "Communal non enriched" housing was an adapted dog kennel measuring 2.3m x 1.6m by 2.4m in height, equipped with 10 single size shelves at varying heights and housing a maximum of 8 cats. The "communal enriched" cage of similar size was equipped with 4 single shelves, one multi-cat shelf, a shelf the full length of the cage and a climbing tower with 3 semi hiding areas. Food and water was placed on different levels and a variety of toys and scratching posts were included. Cats were either adopted, removed from the study for health reasons or eliminated from the study if they were not adopted in 21 days.

Cats in the single non-enriched cages had the lowest adoption rate (45 %), compared to cats in single enriched (76 %), communal non enriched (74 %) and communal enriched (68 %), ($\chi^2 = 9.36$, 3df, $p < 0.05$). For cats that were adopted, the median length of stay was (12.5 days) versus (6.5 days), (4.5 days) and (5.5 days) for other treatments.

These results show that environmental and social enrichment contributed to adoption success of adult cats.

inappropriate therapy, such as the use of punishment for marking behaviour. Inevitably this leads to further distress for the cat, and damage to the pet-owner bond. It is therefore important for veterinarians and others advising pet owners to understand the ethological principles which underlie the development of social stress in the cat, to be able to inform owners, and also practitioners in the significant value of compromised welfare in the domestic cat.

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WELFARE IMPLICATIONS OF SOCIAL STRESS IN THE DOMESTIC CAT

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Introduction

Over the past few years the domestic cat has become more popular as a pet than the dog both in the UK and USA. Despite this, the general level of understanding within the pet owning population about the behavioural requirements of their feline companions is relatively poor. Indeed, although there is some data on the social system and intra-specific communication of cats in feral or semi-feral situations (Turner & Bateson 1998), there is actually very little scientific evidence of how social interaction affects the behaviour and welfare of the cat within the domestic environment. Evidence from clinical cases, however, suggests that the primary reason for the development of behavioural problems in cats is due to environmental stressors, and of these a high proportion relate to social factors. Problems such as inappropriate elimination, spraying, aggression and over-grooming are all commonly linked to relational changes between individuals (Overall 1997). In addition, it is becoming more apparent within the veterinary profession that the aetiology of a number of medical conditions, such as idiopathic cystitis, are associated with physiological stress in the cat (Buffington, Chew, Kendall et al. 1996).

Social stressors in domestic cats

Social relationships with other cats or humans can both enhance or detract from the welfare of the cat. It is well recognised that the early social environment of the domestic dog is important in formulating the type and quality of social interactions later in life (Scott & Fuller 1965). This is equally, if not more, true of the domestic cat, where reactions to other individuals, both feline and human, are strongly influenced by early social environment (Karsh & Turner 1988). Stress commonly arises in the domestic cat where social environments alter from an individual's perception of 'normality', whether this is in terms of quantity, quality or the species with which interaction occurs.

Welfare implications of stress in the cat

The response of the domestic cat to stress is extremely variable, ranging from flight-related behaviours, withdrawn and depressed behaviours, increased reactivity to other stimuli, or behaviours which fall into the category of 'displacement activity', such as the early stages of over-grooming. Because of the general lack of understanding of feline behaviour patterns in the pet-owning public, such behaviours are rarely attributed to environmental stressors. Misinterpretation of these behaviours not only leads to the lack of resolution of the source of stress to the individual cat, but also frequently results in inappropriate therapy, such as the use of punishment for marking behaviours. Inevitably this leads to further distress for the cat, and damage to the pet-owner bond. It is therefore important for veterinarians and others advising pet owners to understand the ethological principles which underlie the development of social stress in the cat, to be able to inform owners, and aid the reduction in this significant cause of compromised welfare in the domestic cat.

Buffington, C.A.T., Chew, D. J., Kendall, M.S. et al. (1996). Interstitial cystitis in cats. *Vet Clin North Am Small Anim Pract*, 26, 317-326.

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BIBLIOGRAPHIC SEARCHING ON COMPANION ANIMAL WELFARE: A WEB-BASED SEARCH TEMPLATE

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Issues relating to companion animals and their welfare are of widespread societal interest. With the advent of websites, many organizations disseminate information of varying accuracy relating to companion animals. However, authoritative sources that provide timely and efficient access to the most current research literature have not been available to the general public and managerial decision makers who need the information. To meet this need, the UC Center for Animal Alternatives has created a search template on companion animal welfare that can be used to conduct electronic searches of bibliographic databases in real time on a variety of specific topics relating to companion animal welfare according to the particular interests of the user.

The concept of a search template builds on the technology for live searching of numerous databases from a single entry point, as is available to users of the California Digital Library, a comprehensive web-based library that is provided to the University of California community. At the Health Sciences Library, UC Davis campus, librarians have developed a suite of search templates on common topics such as animal welfare and human-animal relationships; these draw from databases such as Agricola, Medline, PsycInfo, and CAB Abstracts. Whenever needed, the search can simply be automatically rerun, and the latest information retrieved. The UC Center for Animal Alternatives has created more targeted or focused templates, including refinement in mice research and the unobtrusive study of animals in the wild.

Each search template is created by a librarian using sophisticated bibliographic skills. A complex search strategy is refined and honed to be effective in retrieving the desired available information; this strategy is then saved for other future users as a template. The template also provides the instructional information to help the user walk through the search, thus giving less experienced users required assistance via the web.

This particular search template on companion animal welfare is designed for an international audience. It uses only free databases, including Agricola and Medline, that are accessible to users throughout the United States, or elsewhere, for the cost of the telephone call. The search template provides a framework that is designed to run a search using keywords that have been determined to be relevant to the topic; the search is performed whenever a user requests it, according to the instructions of the user. The search is designed to draw from the most relevant available databases, using the keywords most appropriate for each database and search. Immediate access is thus provided to the most up-to-date, published information.

The search template on companion animal welfare facilitates bibliographic searching on topics of particular interest: to animal shelters and humane societies, such as factors affecting the success of animal adoption and risk factors for animal relinquishment; to pet owners, such as behavior and training; and to veterinarians, such as disease control and animal abuse. This template, or other similar ones, can be extended in further directions according to the needs of specific users.