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# Ethical Issues and Guidelines when Conducting HCI Studies with Animals

**Heli Väättäjä**

Tampere University of Technology  
Korkeakoulunkatu x  
33710 Tampere, Finland  
heli.vaataja@tut.fi

**Emilia Pesonen**

Tampere University of Technology  
Korkeakoulunkatu x  
33710 Tampere, Finland  
emilia.pesonen@tut.fi

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**Abstract**

The number of studies in the field of Human-Computer Interaction dealing with animals has increased in recent years. When planning and carrying out the studies with animals, it is important and necessary to take into account the welfare of the animals as well as deal with the short- and long-term effects of the developed technology and related interventions on animal welfare. This paper addresses the ethical issues and provides guidelines for carrying out studies with animals based on a literature review. The guidelines cover the phases from planning of the studies, to carrying out and reporting the studies.

**Author Keywords**

Ethics, animal, pet, guideline, human-animal interaction, animal-computer interaction, technology.

**ACM Classification Keywords**

H.5.2. User Interfaces: Evaluation/Methodology.

**Introduction**

In recent years the number of studies involving animals has increased in the field of HCI (Human-Computer Interaction). As technology enables remote interaction, tactile and auditory communication and so forth, these issues have been addressed in HCI studies with animals. Concepts used include human-animal interaction, animal-computer interaction and animal-animal interaction, for example.

Most of the animal related studies concentrate on dogs [7][12][26][27][28][34] but also cats [36], poultry [19] or hamsters [8], for example. For non-human primates, such as bonobos in zoos, mobile tablets are being studied and trialed as tools for enrichment, through gaming, media consumption, communication and learning, offering at the same time an opportunity for studying the learning of animals [30].

The uses of technology in animal related studies cover remote training of dogs [27], tracking working [7][28] and hunting [34] dogs, remote command of dogs [7][15], mediating touch to animals or movements of the animal to the owner [19], gaming with the animal [8][35], enriching the animal's life in captivity as well as to study their cognitive skills [30], remote monitoring [36] and mediating communication over distance [12][15]. The stated motivations for technology development in these studies vary: some have utilitarian perspective such as in remote training, tracking and command of canines, whereas some studies state an aim for strengthen the bond between humans and animals or increase welfare of the animals through enrichment by providing activity and mental stimulation. However, only few of the studies consider and report the animal's viewpoint to experience and welfare from both physical and psychological perspective [33].

The key difference between human participants and animal participants is the human's ability to give informed consent. This has consequences in terms of the differences in ethical treatment of humans and animals [22]. Specifically, the animals' inability to speak, jointly with the ability to suffer, has shaped the ethical protocols [22]. Furthermore, EC 1997 Amsterdam treaty protocol desires for "improved

protection and respect for the welfare of sentient beings." We therefore have to be aware of the ethical issues related to animals as participants in the field of HCI as well.

This paper has two main goals. First, we aim to increase the awareness of researchers in the field of HCI to take into account the ethical issues in carrying out research with animals and developing technology for them. Second, we provide a list of ethical issues to consider and present guidelines to help in planning of the studies, carrying out the studies and reporting of the studies with animals. NRC (National Research Council) outlines, how lacking sufficient experimental procedural detail about animal studies in the publications has both scientific and ethical implications: It limits the ability to confirm and build on research findings, it can lead to unnecessary use of animals in studies that fail to reproduce the reported results, it may mask problems in the quality of the research design and conduct of animal studies, and it limits the ability to perform systematic reviews [24]. These impacts may enable questioning the experimental methods and the overall quality of the studies and thus erode support for doing studies with animals [24]. In addition, the transparency on effects of the interventions on animals needs to be ensured.

We first introduce the Three R's and cost-benefit analysis as the guiding principles for any ethical research carried out with animals. We then address the concepts of animal welfare and stress to provide a basis for undertaking what the ethical issues are addressing. Finally, we provide guidelines for doing studies with animal participants in the field of HCI based on a literature review.

Concept	Definition
Stress	A real or perceived perturbation to an organism's physiological or psychological well-being [9]
Stressor	Event that precipitates stress, that can elicit any number of coping mechanisms or adaptive changes [9]
Distress	Occurs when stress is severe, prolonged or both. When stress changes to distress depends on stressor intensity, stressor duration and the capacity of an individual animal to respond and cope with stress [9]
Welfare	State of an animal, and the extent to which it is faring well, or ill in a particular situation or at a particular point in its life [9][25], includes both the physical and mental state [11]

**Table 1.** Definitions for concepts related to animal welfare.

### The Three R's and Cost-Benefit –Analysis

The ethical issues on animal use, starting originally from laboratory experiments, have received increasing attention since the 1950's [9]. The most influential guiding principles for ethical animal research are the "Three Rs" presented by Russel and Burch [29] that are applicable in HCI studies as well: Replacement, Reduction and Refinement.

**Replacement** means that using animals at all or using the particular animal should be carefully considered [9][17][29]. For example, alternatives for the animal might be found from less sensitive species or the individuals chosen for the experiments should be screened based on selected criteria. Replacement may be difficult in case of HCI studies that specifically aim for technology interventions with animals. This emphasizes the need for considering the ethical justifiability of the research and technology development prior to the study.

**Reduction** means minimizing the number of animals used [9][17][29]. Researchers should keep the number of animals at minimum so that the results still remain statistically valid. This is also the most ethical approach, and animals should not be used at all if the same research can be carried out in other ways. Reduction calls for carefully designed experiments and studies that are based on previously published research not only in HCI, but also in relevant other fields, such as animal behavior, applied ethology and animal cognition. Studies and measurements should be clearly defined and repeatable, and they should include the aspects of animal welfare and its assessment within the research design and reporting of the findings. Minimizing the number of animals to a minimum that still provides valid results is important in any ethical scientific research involving animals.

**Refinement** means designing the experiments to minimize stress [9][17][29]. Every individual participating animal should go through as minimum amount of pain, distress and suffering as possible. Refinement calls for science based understanding of animal behavior, cognition, welfare and stress and taking these into account in the research designs of the studies.

ISAE Ethics Committee describes the **Cost-benefit – analysis** which helps researchers to clarify whether using animals in the study is justified: do the "benefits" outweigh the "costs" [17]. The costs mean the harm caused to the animals during the research, and the benefits are the gains to humans, other animal species or the environment [17]. The ethically acceptable option is the one which provides most benefits and involves the least costs: the costs should be decreased to as low as possible and the benefits maximized as far as possible [17].

### The concepts of animal welfare and stress

Here we describe some basic concepts related to animal welfare to ground the ethical issues to concepts. Definitions for the concepts are presented in Table 1.

**Welfare** includes both a physical and psychological component, covering both fitness and a sense of mental wellbeing of the animal [9][11][25]. It is not only concerned with biological functioning but also with affective states such as emotions, pain, suffering and frustration [9].

Any stimuli or event that causes a physiological or psychological reaction or change in an animal causes also **stress** [9]. Stress reactions are normal to any environmental perturbation, and have been separated to eustress (form of positive or physiological stress) and to negative stress (overstress and distress) (Selye,

Original sources addressing animals
Animal Behaviour Society (ABS): " <i>Guidelines for the use of animals: Guidelines for the treatment of animals in behavioural research and teaching</i> " [1]
Animal Computer Interaction (ACI): " <i>Animal-Computer Interaction: A manifesto</i> " [20]
Animal Consultant & Trainers association (ACTA): " <i>Filming with animals: the manual</i> " [3]
American Psychological Association (APA). Ethical principles of psychologists and code of conduct: Humane care and use of animals in research [4]
APA's Committee on Animal Research and Ethics (APA CARE): " <i>Guidelines for the use of nonhuman animals in behavioral projects in schools (K-12)</i> " [5]
Association of Animal Behavior Professionals (AABP): " <i>Professional Practice Guidelines</i> " [6]
Committee on Recognition and Alleviation of Distress in Laboratory Animals, National Research Council. "Front Matter." <i>Recognition and Alleviation of Distress in Laboratory Animals</i> [9]
ELSEVIER: " <i>The Guide to Ethical Information Required for Animal Behaviour Papers</i> " [10]
International Society for Applied Ethology (ISAE): " <i>Guidelines for Ethical Treatment of Animals in Applied Animal Behaviour and Welfare Research</i> " [17]
Medical Research Council (MRC): " <i>Medical Research Council position statement on research regulation and ethics</i> " [23]
National Centre for the Replacement, Refinement and Reduction of Animals in Research (NC3R's): " <i>The ARRIVE guidelines Animal Research: Reporting In Vivo Experiments</i> " [18]
National Research Council (NRC): " <i>Scientific and Humane Issues in the Use of Random Source Dogs and Cats in Research</i> " and " <i>Guidance for the Description of Animal Research in Scientific Publications</i> " [25]
National Research Council (NRC): " <i>Guidance for the Description of Animal Research in Scientific Publications</i> " [24]

**Table 2.** Original sources included in the literature review.

1974 as cited by [21]). **Distress** occurs, when the animal is unable to cope or adapt to changes in its immediate environment [9]. Whereas minor perturbations may be momentarily stressful and they may momentarily negatively affect the emotional state, severe or prolonged stressors or multiple cumulative stressful perturbations may cause long-term behavioral or physiological changes and affect animal's welfare [9]. From the viewpoint of the animal, the predictability and controllability of environment are important factors for attenuating the stress and effect of stressors [9].

The challenge is that there exist currently no direct measures to assess the animal's mental well-being directly [9][25], although some measures exist that can be used as indirect measures of welfare, stress and distress (see [33] for a list of examples). NRC outlines that understanding the normal behavior is the first step in being able to assess and recognize stress or distress [9][25]. Duncan (2005, cited by [9]) suggests that the most important consideration for

assessing animal's welfare is its emotional state [9].

NRC emphasizes that both **stress and distress** need to be taken into account "*in a wide range of experiments and should be proactively addressed by good experimental design*" [9]. Causing distress should be avoided in HCI studies. Instead, both in research and in real-life use of technology we should rather aim for positive effects on animal welfare both in short and long term [33], or, at least minimize the possible negative effects, if they cannot be avoided due to the nature of the activity that is designed for, such as in case of rescue dogs, for example. Researchers who aim to design for dogs, for example, should be aware of not causing behavioral disorders or increased negative stress levels with the technological solutions [33].

### Method for the Literature Review

To address the ethical issues and derive guidelines for HCI studies with animals, we visited especially international animal welfare associations', animal behavior societies', as well as other relevant societies' and organizations' webpages and publications for guidelines for carrying out studies and research with animals. We also included code of ethics by ACM [2] and IEEE [16] as initial sources for inspection. For example, ACM guides with a general guideline: "**Avoid harm to others:** "*Harm*" means injury or negative consequences, such as undesirable loss of information, loss of property, property damage, or unwanted environmental impacts" [2]. Sources that addressed specifically animals in their guidelines and related ethical issues were then chosen (see Table 2) for a closer inspection. The original 3R's from Russel & Burch ([29]) are behind many of the guidelines in these reviewed sources.

In this section and in presented guidelines, with *animal* we mean any live dog, cat, nonhuman primate, guinea pig, hamster, rabbit, or any other warm-blooded animal, which is being used, or is intended for use for research, or as a pet in family households [25]. We exclude exotic animals and wild animals [25] as well as non-human primates.

**Analysis:** First, all the principles and guidelines were read through and those that addressed usage of animals as participants that are applicable for HCI studies were collected. Two or more, same or similar kind of principles were grouped together. Those guidelines that were concerned specifically with animals as laboratory animals, for example in toxicology or bio-medical studies, that we judged as not applicable to HCI research were not included. For example the principle for “*Suffering or death as result*” was excluded [10][17]. We next present the ethical guidelines that were grouped under three phases of research: Planning the study, Carrying out the study and Reporting the study.

### **Derived Guidelines from the Literature Review**

Based on the literature review we present 22 guidelines of which seven (7) are related to the time prior to study, eight (8) when carrying out the study and seven (7) for reporting the study. For some of the guidelines, we also refer to examples how the guideline has been reported when publishing the empirical study.

#### **PRIOR TO THE STUDY: PLANNING**

While planning the study researcher should consider its ethical reasoning and justification, including the technology developed and tested as well as the

procedure, for example. Heleski et al. [13] present some methods (e.g. the ethical matrix) that can be used when doing this. We next present the derived guidelines from the literature review for this phase.

**Justification:** Use animals only if the intent is to advance or develop beneficial, relevant, technology, or the research goals are justified by its prospective scientific, educational or applied value [4][20][23]. Also if the experiment involves exposure to painful, stressful or noxious stimuli it must be considered whether it is justified [10]. Example in [7].

**Legislation:** Relevant current and latest federal, state and local legislation, laws and regulations, for animal care and handling together with professional standards, should be investigated and obeyed [3][4][5][10].

**Proposal:** Written and detailed enough proposal about experiment or study (plan and description of the method and materials used) should be made and approved by a group of professionals such as the Institutional Animal Care and Use Committee (IACUC) [5][10] [23][24][25] or other local or national committee/institution dealing with ethical issues in animal related research.

**Choosing:** Use the best suited species of animals or individuals, and as minimum number of them as possible without the loss of scientific rigour, for the research question posed which are believed to be the least likely to experience pain and distress [4][10] [17][23][25][29]. Avoid using animals if there is an alternative procedure available [4][10][17][23][25][29]. Note, that different individuals of the species and for example in dogs different breeds and breed lines may differ in their personality [32] and choosing appropriate animal

participants may call for screening of participants prior to the study with tools such as C-BARQ questionnaire [14] for dogs. Examples in [7][8][19].

**Research procedure:** Select the least disruptive and stressful techniques together with noninvasive, non-oppressive and non-depriving research methods available in the context of the study: Remove the aversive conditions [10][17][20][29]. Also field studies offer an alternative for investigation [10][17][20][29]. Choose the duration of the study by considering the behavioral characteristics of the animals [17]. Note, that different stimuli and technology interventions may be experienced and reacted to differently by different individuals [32] and the reactions and changes in behavior and welfare should be measured and observed by appropriate methods [33]. See examples later in reporting / research procedure.

**Aversive tools** (such as choke chains, prong collars, electronic invisible fencing or electronic shock-collars) or behavior change methods that create fear or pain in animals (such as leash corrections, helicoptering, hanging, alpha-rolling, scruff-shaking, spraying the animal in the face with fluid etc.) are not to be used in HCI studies [6][17]. In addition, it is recommended not to condone, promote or affiliate with organizations that actively promote unjustified highly intrusive or aversive methods or tools [6]. Instead, positive reinforcement methods are favored in training and habituating of the animals (see “Motivating animals” in next section).

**Personnel training:** Training of caretakers and researchers helps in implementing procedures that foster habituation of animals to them [1][9][10][17]. Habituating the animals to the presence and handling of humans is important because it minimizes animals’

stress [1][9][10][17]. On the other hand, the effects of the presence of humans in research situations needs to be considered, since their presence may affect the validity of the research results interfering with the aims of the study [17]. See example in [7].

#### WHEN CARRYING OUT THE STUDY

The general guidelines for conducting studies with human participants are expanded with the guidelines presented in this section for animal participants.

**Identification:** Non-invasive methods in identification device or marking are used [17]. Also the device’s size should be considered relative to the body-size of the participating animal [17]. Note: this applies also to possible sensors attached to the animal or other technology that the animal carries on its body.

**Responsibility:** Investigators are responsible for the care and wellbeing of the used animals for the whole time and in all conditions of the study: both during the study and in all waiting times [5][10][20][24][25].

**Professional handling:** Investigators must acknowledge and respect the characteristics of all species and individuals, and avoid harming animals behaviorally, emotionally or physically [3][4][5][6][10][17][20][23][29]. Pain, suffering or distress should be minimized both in duration and magnitude, to the greatest possible extent without jeopardizing the aims of the experiment (e.g. the waiting times for animal should be minimized by every effort) [3][4][5][6][10][17][20][23][29]. In addition, trained and experienced staff should be involved in animal research and handling: investigators should familiarize themselves with the appropriate handling methods for the animals to be used [3][4][5][6][10][17][20][23].

**Housing conditions:** In case animals are housed for the experiment or study, animals' housing should be ethically justified, and the caging conditions with the husbandry practices must at least meet the minimal recommended requirements of the country in which the research is carried out [10][17]. Normal maintenance should incorporate as much as possible aspects of the natural living conditions to maximize welfare and survival [10][17]. It should also be considered to or not to provide biologically relevant enrichment features like natural material, refuges, perches or dust/water baths so that animals' welfare should not be endangered [10][17]. Companions should be provided for social animals where it does not lead to suffering or injury [10][17].

Resting areas should be positioned closely to the study area because it is practical [3]. Fresh drinking water, ambient temperature and care for the overall welfare for the animals should be available [3], or justified by ethical justification of the research design if not available. Furthermore if animals are housed the frequency of cage cleaning should represent a compromise between the level of cleanliness necessary to prevent diseases and the amount of stress imposed by frequent handling and exposure to unfamiliar surroundings, odors and bedding [10].

**Approval from the participants:** Investigators must get a full informed approval/consent from those legally responsible for animal participants [6][20][23].

**Motivating animals:** Positive reinforcement methods should be used when accustoming animals to the study set-up [3][10][17] and when habituating them. An alternative reward strategy to the aversive stimulation or deprivation should be considered to minimize the

suffering of the animals by for example using highly attractive foods or other rewards instead of withdrawing it [3][10][17]. If this motivation approach fails, it may reflect the strategy or tactic used, the skills of the research staff and the level of rapport with the animal [3][10][17].

**Monitoring:** NRC points out that both stress and distress need to be taken into account "*in a wide range of experiments and should be proactively addressed by good experimental design*" [9]. The first step in being able to assess and recognize stress or distress is to understand the normal behavior of the animals [9]. The most important consideration for assessing animal's welfare is its emotional state [9]. Therefore animals should be monitored during the experiment or study [18] by appropriate methods. Especially, researchers should be able to recognize signs of fear and specifically extreme fear, such as learned helplessness [17]. See a list of examples for methods of monitoring behavior and welfare in [33].

**Discontinuing:** Participants, also animals, must have the possibility to withdraw, flee or discontinue either temporarily or permanently at any time of the study [17][20].

#### AFTER THE STUDY: REPORTING

In short, the same things that are reported about human participants are reported also when animals are participating added with specific care in reporting ethics related issues. In addition, the issues raised earlier in the planning phase and when conducting the study are addressed in the reporting of the studies. Following guidelines address some specific issues that need to be considered in the reporting.

**Purpose and permissions:** Write specific purpose, plan of action, predicted outcomes and justification for all used methods [5]. Document the ethical review permissions, relevant licenses, national and institutional guidelines for the care and use of animals that cover the research [5][10][18][24]. See examples in [7][31] (see also below in “*Housing*”).

**Procuring animals:** Report how animals are procured and from what source [5][10][18][24][25]. Explain also why the animal species or individuals used can address the scientific purposes [5][10][18][24][29]. See example in [8].

**Housing:** Describe the social features of the animals' proximate environment including details about nature of housing, type of caging and housing paradigm, cage enrichment (e.g. the number of cage companions), bedding material, light/dark -cycle, temperature, quality and source of drinking water and type of food [10][18][24]. Describe also the access to food and water [10][18][24]. See example in [7].

**Research procedure:** Report for each experiment and each experimental group, including controls, all procedures, including details of the used stimuli and apparatus, carried out [18]. Describe the monitoring of the animals during the experiment [18]. Describe any modifications to the experimental protocols made to reduce adverse events, and if some still remain give details of them in each experimental group [10][18][24]. See examples in [7][8][31].

**Habituating:** Explain the methods used to prepare animals for studies: the periods and procedures for quarantine, acclimation, training, and the habituating methods (for experimental procedures) [1][10]. See examples in [7][31].

**Characteristics:** Explain the composition of animals, number of subjects, how many individuals are in each control groups and how many control groups, how control groups relate to the experiment [10][18][24][25][29]. Describe also how they are assigned to the groups [25][29]. In addition, the physiologic status of the animal is appropriate to include [10][18][24]. Describe also the special characteristics, like physiological, anatomic or genetic, of the animals [10][18][24].

Document details of animals used: genus and species (with the proper Latin designation), sex, age, weight and further information like genetic modification status, health and immune status, previous procedures, when relevant [10][18][24][25]. Write down also the number of independent replications of each experiment and information about stocking density and male-female -ratio [10][18][24][25]. See example in [8].

**Analysis:** Document the number of animals in each study group included in each analysis as absolute numbers [5][10][18][24]. In addition if any animals or data were not included in each analysis, explain why [5][10][18][24]. Examples in [7][8][31].

## **Conclusions**

All HCI studies need to take ethical issues into account to ensure the ethical justification of the research and technology development and interventions. This applies also for studies with animal participants. There are means (see e.g. Heleski et al. [13]) to consider the ethical side of the studies, procedures as well as technology interventions with animals. To support high quality and ethical research in HCI studies involving animals, this paper discusses the ethical issues and proposes in total 22 guidelines for planning, conducting



and reporting phases based on a literature review from thirteen original sources. Emphasis of the literature review is on the international animal welfare associations' and animal behavior societies' sources. Presented guidelines in this paper are complementary ethical guidelines for planning, carrying out and

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reporting an HCI study in which animals are participants. Presented guidelines provide a framework for considering the ethical issues in the studies. Application of the guidelines depends on the study in question and its focus.

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