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DEVELOPING A DESIGN GUIDANCE FOR IMPROVING THE WELFARE OF
DOMESTIC DOGS

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

MEHMET SİNAN YAKUPOĞLU

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF SCIENCE
IN
INDUSTRIAL DESIGN

MAY 2022

Approval of the thesis:

**DEVELOPING A DESIGN GUIDANCE FOR IMPROVING THE
WELFARE OF DOMESTIC DOGS**

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ABSTRACT

DEVELOPING A DESIGN GUIDANCE FOR IMPROVING THE WELFARE OF DOMESTIC DOGS

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May 2022, 184 pages

Dogs, living in our houses as family members or furry roommates, might experience difficulties getting used to living in a house and this issues make lasting impacts affecting their welfare at home. Design for interaction solutions achieving user-centeredness can answer the needs of dogs, and technology surrounding us would be facilitated to improve their welfare. As a user group, dogs have different interaction characteristics compared to humans. Informing designers about these differences and including the perspectives of the dog users in the design process is a vital step in reaching for user-centeredness and would help to improve the welfare of dogs for their own benefit. In this study, the main aim is to inform the designers through a list of guidance specific to the dogs living in domestic settings. To form the guidance, various technology cases in Animal Computer Interaction literature are reviewed, and interviews are conducted with dog experts and dog families about their adoption process and the problems encountered. The guidance, addressing directly the designers, starts with the definition of welfare to show the designer the end goal of improving the welfare of the adopted dogs. Following that design challenges are introduced in the form of welfare issues and aids. To put dogs at the center of the

design, guidance continues by offering design features that include the interaction modalities of dogs and design requirements specific to these modalities. In the last part of the guidance, type of participation for dog users to include them in the evaluation process of the developed design solution and methods to be used to understand the behavior of dog users during this participation are explained. The guidance, overall, helps designers to define the needs and characteristics of their dog users before starting their designs and informs them about the techniques to satisfy the communication during the evaluation phase of the developed design solution.

Keywords: Design for Interaction, User-centeredness, Dog Users, Animal Computer Interaction

ÖZ

EV KÖPEKLERİNİN REFAHINI İYİLEŞTİRMEYE YÖNELİK BİR TASARIM KILAVUZU GELİŞTİRİLMESİ

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Tez Yöneticisi: Dr. Öğr. Üyesi Gülşen Töre Yargın

Mayıs 2022, 184 sayfa

Aile üyeleri veya tüylü ev arkadaşları olarak evlerimizde yaşayan köpekler, sahiplenme sonrasında ev yaşamına alışma konusunda zorluklar yaşayabilir ve bu sorunlar evdeki refahlarını etkileyen kalıcı etkiler yaratabilir. Kullanıcı odaklılığın sağlandığı etkileşim için tasarım çözümleri köpeklerin ihtiyaçlarına yanıt verebilir ve bizi çevreleyen teknoloji onların refahını iyileştirmeye hizmet edecek şekilde kullanılabilir. Bir kullanıcı grubu olarak köpekler, insanlara göre farklı etkileşim özelliklerine sahiptir. Tasarımcıları bu farklılıklar hakkında bilgilendirerek köpek kullanıcıların bakış açılarını tasarım sürecine dahil etmek, kullanıcı merkezliliğe ulaşmak için önemli bir adımdır ve köpeklerin refahını kendi yararları için iyileştirmeye yardımcı olacaktır. Bu çalışmada amaç, ev ortamında yaşayan köpeklere özel bir rehberle tasarımcıları bilgilendirmektir. Bu rehberi oluşturmak için Hayvan Bilgisayar Etkileşimi literatüründeki çeşitli teknoloji çalışmaları gözden geçirilmiş, köpek uzmanları ve köpek aileleriyle sahiplenme sonrasında evde yaşanan sorunlara dair görüşmeler gerçekleştirilmiştir. Doğrudan tasarımcılara hitap eden rehber, nihai hedef olan sahiplenilen köpeklerin refahını iyileştirmeyi tanıtmak için refahın tanımıyla başlar. Bunu takiben, refah sorunları ve yardımlarından oluşan tasarım zorlukları tanıtılır. Köpekleri tasarımın merkezine koymak için, köpeklerin

etkileşim modalitelerini ve bunlara özgü tasarım gereksinimlerini içeren tasarım özellikleri sunarak tasarımcıya yol gösterir. Rehberin son kısmında, geliştirilen tasarım çözümünün değerlendirme sürecinde köpekler için seçilebilecek katılım tipleri ve bu katılım sırasında köpek kullanıcılarının davranışlarını anlamak için kullanılacak yöntemler açıklanmıştır. Rehber, tasarımcılara tasarıma başlamadan önce köpek kullanıcılarının ihtiyaç ve özelliklerini tanımlamada yardımcı olur ve geliştirilen tasarımın değerlendirmesinde iletişimi sağlayacak teknikler hakkında tasarımcıları bilgilendirir.

Anahtar Kelimeler: Etkileşim için Tasarım, Kullanıcı Odaklılık, Köpek Kullanıcılar, Hayvan Bilgisayar Etkileşimi

To my cat daughters, Piston and Jeton

ACKNOWLEDGMENTS

First and foremost, I would like to express my gratitude to my supervisor Assist. Prof. Dr. Gülşen Töre Yargın for her guidance, positivity, patience, and never-ending support throughout this study. Without her, it would not be possible for me to complete this challenging yet inspiring journey.

Coming from the field of engineering, doors of a whole new world opened in front of me from the very first moment I stepped into the METU Department of Industrial Design. Along the road of fascinating discoveries, every single one of my dear friends and precious faculty members embraced me and shared their unconditional support. I am sincerely thankful to all of you.

I would like to thank Assoc. Prof. Dr. Yasemin Salgırlı Demirbaş for her interest, starting even from the ideation phase of this study. Her wisdom helped me to shape the path of this thesis.

I also would like to thank my human and dog participants for sparing their time and taking me to their homes.

A special thanks to Ege. He put up with all my ups and downs, encouraged me with realistic pep talks, and became the everlasting source of motivation for me.

Last but not least, I will be forever grateful to my family, my father Bekir, my mother Hülya, and my sister Sinem, for always being there for me and believing in me. I am who I am thanks to them.

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CHAPTER 1

INTRODUCTION

We, humans, are animals. Being part of the same animal kingdom, our lives and the lives of non-human animals are inevitably intertwined. Interaction between us started thousands of years ago by sharing the same habitat together. Rooting from this co-habitation, different types of relationships are sprouted throughout history. Wild animal life continued to grow without human influence as much as possible. Animals encountering humans, on the other hand, are assigned some roles by us. As our co-evolution progressed, domesticated ones become our companions as pets in homes. Some are trained to be working animals in various cases from search and rescue (Zeagler et al., 2016), to medical diagnosis (Mancini, Harris, Aengenheister, & Guest, 2015) or to assist people with different impairments and disabilities (Byrne, Zeagler, Freil, Rapoport, & Jackson, 2018). The detrimental nature of humans turned some of them into captive animals to be exhibited in zoos. Some captive animals are the victims of the animal trade, some for the entertainment of humans. Some were lucky to be saved from captivity and given a new life in wildlife rescue centers (Hanna Wirman & Zamansky, 2016). Inevitably, a substantial portion of animals become the main sources of industries like food and clothing for human benefits. To be added to these benefits, they become test subjects for cosmetic and medical experiments as well.

With its positive and negative sides, as the level of interaction between humans and animals change from a minimum to a daily basis, routines forming us humans' day-to-day lives started taking place in animals' lives as well. In our modern world, we are all surrounded by design solutions. Products and systems designed and developed for us, humans, follow us during the day, from the minute we wake up until we go

to bed and even in our sleep by tracking our wellbeing (Swan, 2013). Technology with its comprehensive types and capabilities is integrated into such design solutions. Technology, at the core of the modern world, targets us, humans, as the sole user. However, animals, from which we cannot separate ourselves anymore, are as much as affected by the technology and what it brings, if not more. They ultimately become the unintentional and indirect users of these very same artifacts.

There are different research fields and design practices placing the user in the center of the focus. With the gained momentum of user-centered design, studies in the practices such as participatory design, empathic design, and design for intent are developed to comprehend not only the physical but also the emotion and experience-based needs of the user. The definition of the user in most of these studies, however, is strictly restricted to humans. With the focus shifting towards the world equipped with technology, fields such as design for interaction (IXD) and human-computer interaction (HCI) started dealing with the relation between humans and technology. Since they all accepted humans as the intentional and direct users, methods and approaches in all studies are shaped for humans. Animals are not accounted for as potential users, and hence the potential subjects in the studies.

This perception has started changing with the raised questions regarding animal welfare and ethics. On July 2, 2012, a group of scientists gathering at The University of Cambridge published a declaration on the consciousness of animals (Low, 2012). Declaration stating humans are not unique in possessing neurological constituents resulting in consciousness lead the way for numerous studies and discourses about the perception of animals by humans and the perception of humans themselves among the animal kingdom. With the presented results regarding consciousness and sentience from animal studies, the perspective toward animals began to change. People's knowledge about animals began to increase with the studies on the physiological, psychological, cognitive, and behavioral characteristics of animals. As a result, people's approach to animals has changed. Studies conducted for humans with humans transitioned into multispecies studies with the addition of other species. All these developments had an impact on the field of design as well. Fields such as

ACI (Animal Computer Interaction) emerged, and animals began to be accepted as users.

After the acceptance of animals as users, the design era for animals has started. Different animal species were chosen as participants for design research studies from elephants (French, Mancini, & Sharp, 2016) to orangutans (H Wirman, 2014), horses (North, 2016) and many more. Products developed for pet animals created a sizeable market. Especially design solutions developed for the technological interaction of dogs become popular. It is helpful to discuss the rationale of the need behind the development of such solutions.

In everyday life, where humans and dogs share the same domestic setting, there are many different technological products such as televisions and tablets that humans use to maintain their daily comfort and have fun in their spare time. The time human companions are at home coincides with the time they spend with their dogs. When human companions want to share common activities with their dogs by including them in these activities during these time periods, they expose their dogs to the technological products they use. Humans who are integrating technology into every aspect of their lives, want to maintain the same habits when they are away from home and seek ways to connect with their dogs through technology. Humans' attachment to their habits causes examples such as remote communication with dogs via video-chat (Golbeck & Neustaedter, 2012). At this stage, one path to follow to satisfy dog-centeredness in design is to revise the products that people share with their dogs with features that dogs can perceive, use and benefit from.

Dogs' basic needs and capabilities, however, often do not match these products and their affordances. Herein, it becomes important to redefine the roles of dogs from 'usees' (Baumer, 2015) to active users. Up to this point, dogs can be defined as 'usees' because they are explicitly targeted to technological design solutions through their human companions, they are unaware of their targeting via technology due to their differences in perception, and they do not give any consent due to differences in our communication channels (Baumer, 2015). In the developing technology

world, dogs will never be isolated from technology as long as they live with humans. For dogs to be accepted as active users rather than ‘users’ in this technology dominant world, designers should include the dog's needs into the design requirements for products that humans and dogs use together or focus on the design and development process of dog dedicated technologies in which dogs' behaviors, capabilities, and practices are engaged.

In this process, including dogs in the design is an important step to understand that the results of the design and production activities carried out by humans do not only affect themselves but also affect the animals and plants with which humans share the same environment. In the academic literature, these studies are carried out as multispecies studies. Latour (2005) defines humans and nonhumans as co-actors in an interconnected network having an impact on each other. Verbeek (2011) states that humans are shaped together with the technological artefacts in their technological interactions and sees non-human artefacts as an active part of their interaction. Acknowledging nonhuman actors is a starting point for questioning anthropocentric design activities. However, anthropomorphic thinking cannot be completely abandoned as long as the human being is the one who carries out the design. At this point, Haraway (2008) suggests creating opportunities to explore together so that humans and animals living together in the world can understand each other. She states that with such explorations humans can *become with* animals and respond to them with respect with a shared understanding. Putting the outcomes of these academic activities into practice will help increase awareness and enable the spread of dedicated designs for non-human living things, not only animals but also plants and other matters as well, in the future of design.

In the implementation of this multispecies approach, however, there are observed problems in the literature and the practice. The fact that it is human beings that are giving design decisions for a user group from a different species made the human influence and bias inevitable. Designers, as humans themselves, start working with their human users with a mutual understanding. They share a common language and common experiences. They communicate in numerous ways to understand their

needs, and further on continue their design process with the methods specifically developed for humans. When it comes to their non-human users, the lack of communication between designers and their animal users becomes apparent. The problems observed regarding the designs made for animals due to the influence of humans can be gathered into three groups:

1. Products that are claimed to be animal-centered were developed without considering the benefit of animals as a premise. As a consequence, they turned into products that are used by animals to fulfill the benefit of humans (Alcáidinho, Valentin, Abowd, & Jackson, 2016), (Byrne et al., 2018), (Byrne, Zuerndorfer, et al., 2018)
2. Developing design solutions according to the humanized usage scenarios for a product that the animals interact with, results in obtaining designs that are not suitable for the perception and interaction modalities of the end-user (Golbeck & Neustaedter, 2012).
3. Perspectives of the animals as end-users cannot be integrated into the design process due to our differences in communication channels (Logas et al., 2018).

The first problem arises with the misplaced focus on the benefit. While developing design solutions for animals, their benefit should be understood and interpreted correctly. It is only natural to have common interests for animals living with humans. However, specifying the user correctly is essential for the design to be developed to address the right user needs. ACI with its starting manifesto (Mancini, 2011) suggests a user-centered approach to put the welfare of animals into the center of any study that will be performed with animals. This suggestion turns designing for animals into designing for animals with animals.

We can consider the interaction design studies with working dogs as examples of studies in which dogs are users, but whose main purpose is to contribute to the human benefit. Increasing the communication between guide dogs and the human they accompany through conversion of taught head gestures of the dog by the technology

integrated into his collar (Alcaldinho, Valentin, Abowd, & Jackson, 2016), or an assistance dog informing the relevant authorities in case of an emergency in the house by selecting the virtual targets on the touchscreen in a certain pattern (Byrne et al., 2018) are example studies of human benefit priority. A changed focus of benefit does not mean that participant dogs are harmed, given that these studies are carried out in accordance with ethical rules. These studies are important to create a pool of information for understanding the relationship of dogs with technology, yet the result of the study does not contribute to an increase in the welfare of the dog. Therefore, although dogs are the primary users in these studies, it can be claimed that they are used as instruments. Another example where the benefit of humans is aimed is the study with the purpose of evaluating the potential of dogs to become working dogs by measuring their temperament using smart toys comprising sensors sensitive to pressure (Byrne, Zuerndorfer, et al., 2018). The study, which contains information about how long and costly training a working dog is, emphasizes how many millions of dollars can be saved annually if the suitability of puppies can be understood through play interaction. Although the interaction of dogs with instrumented toys yields results that will contribute to the design studies, the focus is on the benefit of the human.

The second problem comes with disregarding the differences between animals. While designing for animals with them, even though that is stating the obvious, we cannot talk to animals or expect them to talk to us in return, as much as some of us would like to. Hence the expectation that anthropocentrism can be utterly eliminated is unrealistic, at least in the competencies of this era's technology. Having stated that, by realizing and accepting that anthropocentrism cannot completely disappear, it is an important start for designers to get to know their animal users so that humanization can be minimized. Learning about the perception and interaction modality differences of humans and animals means equipping the designer with the right tools for the process.

Golbeck and Neustaedter's (2012) study, which focuses on the communication between the dog and the human companion by video-chat, is an example of both the

human benefit priority and the anthropocentric approach to dog perception and interaction modalities. It is quite ordinary for a person to satisfy his longing by video calling his distant relatives, to see his dog through the 'pet video chat' system while he is away. However, for the dog, which tries to recognize the human or animal it encounters by its smell, this is not an example that can be met with much response. The system, which requires the dog to stay in front of the computer at a certain point in the house, focus and maintain its focus in a way that does not overlap with the general movement habits of the dog, aims to attract the attention of the dog with elements such as different sounds or laser pointer movement under the control of the human companion. The study hardly touches on the frustration that the dog may experience, which is confusion because it hears but cannot smell the human companion (Golbeck & Neustaedter, 2012).

The third problem shows itself when the perspectives of animals are not included in the design process. Designers equipped with the right tools for getting informed about the characteristics of their dog users take another step towards effective interaction with their users, even if they are not sharing a synchronized communication channel. Since methods used in the research studies and design practices are abundantly developed for humans, human bias and its consequences take effect while working with animal users. Having ruled out verbal communication, designers need to seek dog-centric methods to understand the thought process of their users to the possible extent. For this, one of the methods followed in the ACI literature is the participatory design. An environment is provided for animals to "express their opinions", even on the basis of preference, on design solutions to be developed for their own use. Although this is not the only method that can be applied, it shows promise as a method adapted from studies conducted with humans. Solutions for animals developed by a human designer only, even if the designer has become familiar with the animal user's features, are often under-evaluated for usability and deprived of feedback from the end-user. Assuming a type of technology highly used by humans is adaptable to animals as well, a respectable group of researchers develops a toolkit for animal touchscreen slider design (Logas

et al., 2018). Even though the study separates itself from the field of HCI and takes account of prior ACI studies, it leaves the end-users out of the study. The result shows a design solution developed for dogs without the participation of dogs.

The majority of technology interaction studies for dogs have been conducted on working dogs using training. Since they were raised as working dogs, they are chosen to be trained to fulfill the tasks of the study, and finally, complete the task with the motivation of the food reward they will receive. In these types of studies, the dog does not display its own opinion and focuses on reaching the reward at the end of the task. Another important step in achieving user-centered design is for the designer to be aware of the non-training-based methods that can respond to the free will of dogs. In studies of domestic dogs, we see examples where the dog wears wearable technology with health and location trackers integrated into its collars and is tracked both physically and healthily by its human companion, so even though the dog is the primary user, it does not interact with the device actively (Mancini, Van Der Linden, Bryan, & Stuart, 2012). Although the dog's participation is provided here without training, since there is no active interaction, it is not possible to obtain information about the dog's preferences and iterate the design accordingly. Another study based on the playful interaction, in which the dog living in the house participates as an active user, provides a common communication opportunity between the human and the dog. It shows a promising path that can be followed for dog-centricity (Westerlaken & Gualeni, 2016).

In scenarios where the dog is a participant, if the communication with the dog is carried out only through the preferences of the dog, the integrity of the meaning may not be achieved. For this, observing and interpreting the dog's behavior and body posture is a method preferred by the human designer in order to understand the dog in terms of communication. Ethograms, in which dog movements are associated with body postures, are used in the ACI literature, with studies such as the study to understand the tail movements of dogs (Ruge, Cox, Mancini, & Luck, 2018). Increasing the number of ethograms prepared specifically for the context of the study and turning it into a method frequently used in design studies for animals can be an

approach that strengthens the communication between the dog user and the human designer.

Understanding the physical, cognitive, and behavioral characteristics of dogs in order for reach dog-oriented design studies to reach user-centeredness is a critical point for both design researchers who can develop dog-centric methods and designers who can benefit from the results of the studies produced as a result of the developed methods. However, when I started to research the characteristics of dogs, the information I could find was in the form of very independent pieces in disciplines such as veterinary science and animal studies, which have quite different languages compared to the design literature. Studies examining the gustatory characteristics of dogs (Boudreau, 1989), visual characteristics of dogs (Peichl, 1991), (Miller & Murphy, 1995) or color perception in dogs (Neitz, Geist, & Jacobs, 1989) reveal important inputs for design requirements. Studies investigating the separation related behaviors of puppies and dogs (Lund & Jørgensen, 1999), (Frank, Minero, Cannas, & Palestini, 2007), (Scaglia et al., 2013) help designers to understand the issues of their target users. However, due to field differences, these all need to be decoded to implement into the design studies. In the ACI case studies with dogs, it is understood from the narratives or from the references of the publications that this information is deducted and used as a basis to be built on. This means that every design researcher is trying to reach this information from this scattered information pool and turn it into a design input. However, the shortcoming I observed in the literature, which is the biggest factor in the emergence of this thesis, is the lack of resources where the characteristics of dogs are collected and reported in a way that can make design input to interaction design studies while making a user-centered design for dogs. The creation of such a body of knowledge for dogs helps design researchers and designers to base their design work on dogs. This can also help prevent another shortcoming which is developed design solutions from not being properly documented, as it will lay the foundations for design work. In the continuation of the path followed in technology interaction studies with dogs, the fact that the feedback of dogs or the comments of the animal behavior expert, who is included in the study for the

interpretation of dogs' behavior, are not clearly reported together with their rationale, affects the further usage of obtained information in the upcoming studies.

1.1 The Aim and Research Questions of the Study

Considering the issues encountered, the main goal of this study is to support designers who are to design for animals in a specialized use context. To put it more clearly, this study aims to inform and guide designers to achieve a user-centered design for adopted dog users by incorporating the perspectives of dogs into the design process to improve their welfare in domestic settings.

When a design project is aimed to serve nonhuman users, it is inevitable for the designers to consult a behavior expert to grasp the modalities of their specific users. Even though ideal, it is impractical to involve such an expert in each step of the design process. Animal behavior experts have a vast amount of knowledge regarding the species in concern. However, the designer does not need to know all of these to perform their design. With guidance to follow, context-related and species-specific information can be accessible to the designer regarding the different design parameters.

By enhancing the awareness of the designers towards the differences of this specific user group, achieving the ultimate goal of designing for animals can be reached without the dominating effects of anthropocentrism. We can treat the animal users as individuals only by accepting the fact that there is no supremacy of humans over animals, and by realizing that they are distinct living beings having their own intelligence, emotions, and species-related behaviors, physical and cognitive capacities. Treating them as individuals would help to rule out the human bias and this, in return, will help the designer to see the animal user with its unique characteristics and to approach accordingly.

To help the designers who are willing to create design solutions for animals, this study aims to support them with guidance. Specifically developed for the species in

concern, such guidance would help designers to come to a level of shared knowledge with the animal behavior experts for the related context and offer them alternative ways to try out while working with their animal users. When we say animal, we do not refer to a single specific species. There is a high number amount of animal species grouped into vertebrates and invertebrates. For design guidance to be successful, it must be tailored to the modalities of a species. In my thesis study, I have chosen dogs as the species to be concentrated on. As I have discussed in the previous section briefly, there is a variety of well-grounded studies in different fields such as veterinary science and animal studies working on and giving detailed information regarding the physical, cognitive, and behavioral characteristics of dogs. Gathering the results of these studies under a single structure and translating them into a language and format that designers can use will be an effective output for designers in terms of getting to know the non-human users and being aware of their differences. Conducted literature studies in the ACI field regarding dogs, as deliberated briefly in Section Error! Reference source not found. and will be discussed in detail in the following sections, dividing them into two main categories of working dogs and domestic dogs. The context of study in my thesis is adopted dogs living in domestic settings and the main purpose of the guidance is to help designers improve the welfare of these dogs. There are several reasons for selecting adopted dogs as the specific user group. First, being domestic animals, they are accustomed to having humans around and actively interacting with them. This close relation minimizes the effect of disturbance that might be caused by the human researcher and designer both for this study and for the possible future studies based on the guidance created. Second, design solutions that will increase the adaptation of dogs to the home can make a significant contribution to the welfare of this animal group by encouraging people to adopt dogs.

Working dogs and adopted dogs, being a part of the same species, share similar physical characteristics depending on their breeds, gender, and age. However, the motivations of adopted dogs depending on their pre-adoption life and the behaviors they show accordingly differ from the motivations and behaviors of working dogs.

The fact that most of the studies on dogs in the field of HCI select working dogs as their participants causes less accessible information to be used in the field of design. In addition, studies in which working dogs are participants are designed to train them to complete the tasks of the study and this directly affects the methods for including dogs in the design process. For this reason, the choice of adopted dogs as the target audience has the motivation to encourage the designer to involve the dog in the design process in more participatory ways. In this way, it makes a contribution to providing user-centeredness for dogs.

With these aims, this study seeks answers to the following main research question:

How can designers be guided in designing for improving dog welfare?

I divided this key research question into the following research questions to explore the idea thoroughly:

1. What are the design requirements for designs aimed to improve welfare of dogs in domestic settings?
 - a. Which interactional characteristics of dogs should be considered by designers to center dogs in the design process?
 - b. Which design parameters are effective for improving welfare of dogs in domestic settings?
2. Which considerations should be taken into account in the design process for designing for dogs?
 - a. What kind of a process should be planned for research and design phases to include dogs' perspectives?
 - b. Which differences of dogs compared to humans should be paid attention to?

1.2 Structure of the Thesis

This thesis consists of six main chapters. Introduction as the first chapter expresses the reasons behind this research study by presenting a background. The main aim to conduct this research is explained and research questions are introduced.

The second chapter presents a literature review that is formed of two main parts. The first part focuses on the field of Animal Computer Interaction. In this section, theoretical basis is covered not only with the literature from the ACI but also from animal studies as well. The second part of the chapter focuses on the welfare of animals. Anthropomorphism is defined and anthropocentrism coming along with it is introduced, so that while conducting studies with animals these terms and stances can be distinguished and avoided as much as possible. Afterwards, welfare issues examined in the literature for adopted dogs are introduced along with the strategies for welfare improvement.

The third chapter gives detailed information about the research methodology followed in this study. Research questions are matched with the sections of the thesis for the traceability. The chapter comprises two main stages of this study, literature review and interviews. In the literature review part of the methodology, keywords used to obtain the material to be reviewed and filter criteria used for the materials are explained. Grouping of the reviewed raw data is given with its rationales. In the interview part of the chapter, information regarding the content of two-staged semi-structured interviews conducted with two different sample groups, animal behavior experts and dog families, is presented. Characteristics of the participants in the dog family interviews are tabulated. Thematic analysis procedure for the dog family interviews is explained.

The fourth chapter presents the results obtained from the literature review of ACI cases and from the interviews conducted with animal experts and dog families. Literature results part cover the participant varieties, modality usage and related design requirements for the chosen modality, methods to make sense of the dog

participant's behaviors in the scope of ACI case studies. Details of the examined cases are given in Appendix A. Interview results part of the chapter follows a reporting narrative. Results of the expert interviews reveal information about the background relation of adopted dogs, welfare issues they might display, design features and methods for understanding the dogs. Results of the family interviews focus on the experience families go through with the adoption process, pre and post adoption issues and strategies for adaptation to their new routines.

The fifth chapter represents the design guidance for improving the welfare of adopted dogs living in domestic settings. Guidance starts with a How-to-Use and directly addresses the designers in the narrative. Three main parts of the guidance is comprised of design challenges for welfare improvement, design features for dog users and methods include and understand the user to the evaluation of the developed design solution.

The sixth chapter being the conclusion chapter revisits the research questions and explains how they are dealt with throughout the study. Beneficiaries of this study and the limitations of the conducted study are explained. By introducing the possibilities of the future studies to be built on the research conducted within this thesis chapter is concluded.

CHAPTER 2

LITERATURE REVIEW

When designing for animals, determining the needs of animals is an important factor in positioning them as the first user. Understanding animal welfare, being aware of humanization, and avoiding it as much as possible by using animal-centric methods are important steps to include animal perspective in design to satisfy user-centered design for specific species.

In this chapter, the Animal Computer Interaction field, which focuses on design for animals, is introduced, and based on general approaches to the welfare of animals, the studies in the literature on the well-being of dogs living in domestic settings are examined.

2.1 Animal Computer Interaction

In this section, theoretical side of the field of ACI which is focusing on the design studies on the interaction of animals with technology is reviewed. How it became a separated field on its own, what are the experienced challenges and ethics to be paid attention to in the studies are introduced. To understand the involvement of the dog users, methods of their involvement to the studies and techniques used for these methods are reviewed in the related section. To learn about the specific user group of dogs, factual information regarding their sensory abilities that could be helpful as inputs for the design requirements are explored from the literature of animal studies.

2.1.1 Emergence of the Field

Different academic fields select animals as their subjects. To name some main fields, *animal behavior* (i.e., *ethology*) deals with the behavior of animals, *animal science studies* focus on domesticated animals, *biology* is concerned with fundamental principles of life on earth, *veterinary medicine* as a subfield of medicine has its patients of domesticated and wild non-human animals, *ecology* explores interactions of organisms in a broad sense with their environments and *zoology* investigates the interactions between animal systems and their environments. Besides these practical and scientific fields, there are disciplines like *critical animal studies* and *animal political theory* working on more philosophical perspectives regarding animal welfare and ethics. When we come to the academic fields dealing with interactions of users with technology and computer-mediated technology specifically, *design for interaction* and *human-computer interaction* can be stated as two main disciplines. Although interaction of animals with machines is investigated in such areas as automated milking systems for cows (Rossing, Hogewerf, Ipema, Ketelaar-De Lauwere, & De Koning, 1997), perspectives of animals are not taken into account in these designs since animals are not considered as active users. The benefit of the technology usually serves humans, and animals do not take part as a stakeholder in any of the design phases. A field centering on the perspective of animals towards technology where they act as the primary users was lacking. Even though most the studies performed in the human-computer interaction field focus on adult humans, a few studies chose children and non-human animals as the subjects. One of the early studies subjecting animals in HCI (McGrath, 2009) compiles “species-appropriate” pioneering works performed with dogs, cats, cows, poultry animals, and hamsters. It mainly tries to show that it is technologically possible to have animals as users. McGrath (2009) encourages other researchers to question the variation in assumptions and methods that working with non-human users can add to the design. The deficiency of such a specific field ended with the emergence of the *animal-computer interaction* field. The discipline of ACI started by separating itself from

HCI and manifesting that perspectives of animals have to be accounted to develop technologies for animals (Mancini, 2011). If we extrapolate the logic in HCI to ACI, studying the viewpoint of animals regarding their experience with technology would be possible through animal-centric studies and their participation.

ACI is the most prepotent area dedicated to animals in the design literature. Its main goals are to develop technology to serve the benefits of animals and to empower the relationship between animals within their own species and with other species, including humans. For this purpose, studies are carried out with animals from a variety of species using different technologically mediated design solutions to reach for various aims. Some of these examples are the enrichment of captive elephants by playful objects integrated into their living spaces (French, Mancini, & Sharp, 2017b), strengthening communication between cancer detection dogs and their trainers (Mancini et al., 2015), monitoring the free-roaming pigs by tracking their movements to classify their behaviors (Haladjian, 2017), and increasing the welfare of captive giraffes by thermal camera monitoring (Dong et al., 2017). Studies specialized in dogs are reviewed more comprehensively in Section 4.1.2.

2.1.2 Challenges of Studying with Animals

If we look at both animals in general and dogs in particular, one of the main concerns for the research and design with animals lies in communication. Human researchers and designers cannot communicate with animals as they do with other humans. Verbal communication through words is out of the question, so they must discover and adopt other ways to decipher the meaning of animals' interaction with technology or any product in general. When the interaction between different species is to be understood, interpreted, and directed, it is necessary to talk about communication and sense-making. If we go to the fundamentals regardless of the communication channel, signs as the conveyor of meanings come to the focal point of the discussion. Kohn (2007) aims to go beyond the human-animal dualism by

examining the sign interpretation processes suggested by Peirce (1931-35, as cited in Kohn, 2007). Accordingly, the signs are divided into three as follows:

- Symbols: These are culturally learned signs that are bearing no similarity to what they represent. Word *dog*, number *16*, or formulas in scientific studies could be examples. They are abstract.
- Icons: These signs have the resemblance of what they are representing. Physical connection in the level of depiction is available. A map or a photograph is a self-expressing example for icons.
- Indices: These are physically grounded signs. They are the physical evidence of what they are representing. The footprint of an animal, dark clouds for representing rain, the smell of sweat could be examples for indices.

Humans communicate using a mixture of all these three mechanisms. For non-human species, however, the first two types of signs are too abstract. Indices, on the other hand, are accessible and meaningful to non-human species, including dogs. For these reasons, Kohn (2007) believes that communication between animals and humans can be achieved with indexical semiotics that can be built on indices. This is an important implication for design, setting boundaries for meaningful input. Indices placed in a context can be a common communication tool for both dogs and humans. In an ACI study, researchers place location trackers on dogs' collars and explore indexical semiotics obtained through these devices (Mancini et al., 2012). With the spatial changes of their dogs that could be monitored from the tracker, human companions get an idea about how their dogs spend their time. For dogs, although we cannot get an idea of what tracking as a process means to them, it is observed from their body reactions that from the moment they see the collar in human companions' hands, they relate it to the upcoming activities. This association turns the device into a meaningful object for them. Knowing the whereabouts of their dog gives a sense of confidence to the human companions. This feeling creates a change in humans' behavior, such as unleashing their dogs during their daily walk-outs. In return, dogs' frequency of checking out their human companions and their attempts for play

initiation changes. With a technological medium, the communication between them changes and develops. In the effort of developing nonverbal communication methods with animals, discovering such signs that can be used for interaction designs can be promising.

2.1.3 Ethics in ACI

Challenges in ACI begin when we think of animals as the participants of research studies rather than just instruments of the research. With humans, it is an elementary step to inform them about the details of the study and take their consent for their participation. When animals are concerned, their informed consent cannot be taken in a written or verbal way. Hence, the researcher must provide necessary means to animals so that ethical research could be fulfilled. Vääätäjä & Pesonen (2013) draws attention to ethical concerns while working with animals in research studies in the beginning phases of ACI field within the scope of HCI. They refer to *the Three Rs* created by Russel and Burch (1958, as cited in Vääätäjä & Pesonen, 2013) which stand for replacement, reduction, and refinement. *Replacement* means removing animals if it is not certainly necessary for the study or choosing an alternative considering the sensitivity of the species. Using the minimum number of animals that would give a statistically valid result covers the *reduction* step of the principle. *Refinement* is used for building and fine-tuning the study with principles to minimize the stress animal is exposed to. When the principle of *The Three Rs* is applied for the design studies, it is hard to execute the replacement step, because studies are designed for the specific animal user. Their individual experience, reactions, and preferences lead to the iteration of the process. However, as the first step toward the welfare of the animal, reduction and refinement steps can be implemented while designing the research.

While designing a research study to be conducted with animals, the duration of the study, tools and methods to be used for changing behavior or motivation needs to be selected carefully, and appropriate to the participant species to avoid any aversive

ramifications. Preventing any encounter with surprising factors is important for reducing the stress of the animal and giving control over the environment to the animal supports the feeling of comfort.

2.1.4 Dog Participation

In the ACI community, it is an ongoing debate that up to which level the control shifts from human to animal during the design process (Mancini & Lehtonen, 2018). To be able to reach user-centered design for animals, it is vital to understand the actual needs of animals and to reflect their perspective on the design choices for improving their welfare, not only for the benefits of humans. A human designer performs this reflection nonetheless, hence anthropomorphism becomes inevitable. It is possible to achieve a balanced engagement between design researchers and their animal participants by providing some level of participation to animals with methods exceeding humans and aiming for multi-species. In this way, they do not remain as mere users but turn into possible co-designers (Westerlaken & Gualeni, 2016).

DLOP, short for Doggy Ladder of Participation, offers a categorization for the involvement of dogs in the design research (Hirskyj-Douglas, Read, & Cassidy, 2015). Participation of members in a study means creating an influence by expressing individual opinions. In a design research study where humans and dogs become co-participants, the language-based transmission fails to be achieved because of the communication asymmetries. DLOP suggests creating and following methodologies where dogs feel heard for their needs, ideas, and preferences during the process. They can express themselves more freely thanks to this feeling, and consequently, this paves the way for their participation.

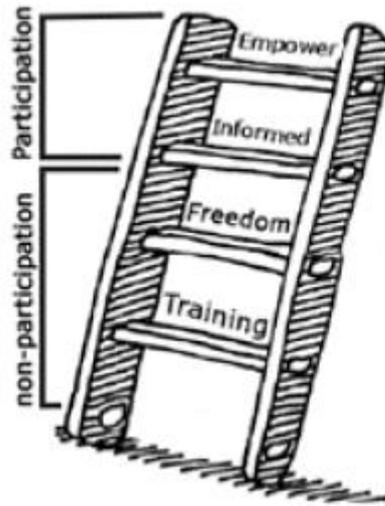


Figure 1 – DLOP (Hirskyj-Douglas, Read, & Cassidy, 2015)

The ladder consists of two main parts, namely non-participation, and participation.

2.1.4.1 Non-participation

The first rung of non-participation part is **training participation**.

If there is a complex series of behaviors to be achieved by dogs to interact with the technology, researchers use different training methods to introduce and teach the tasks. Working dogs are selected as subjects for such studies because they have already had certain pieces of training (Alcainho, Valentin, Abowd, & Jackson, 2016), (Byrne et al., 2018).

When the term training is used with dogs, working or not, all dogs become recipients. As a part of adaptation to domestic life, companion dogs are trained with different methods to prevent behavioral problems and strengthen the dog-human bond (Hiby, Rooney, & Bradshaw, 2004).

The main idea in dog training is to modify specific behaviors through associative learning. Behavior psychology studies this learning process in two fundamental phenomena, namely classical and operant conditioning.

In *classical conditioning*, an unconditioned stimulus is associated with a naturally occurring, involuntary behavior through a neutral stimulus. After the association, the neutral stimulus becomes a conditioned stimulus and creates the conditioned response (Wolpe & Plaud, 1997). Pavlov’s study with dogs and their salivary response is the most known and pioneer study in classical conditioning. However, its applications with different forms are investigated in various behavior therapy cases.

In *operant conditioning*, a voluntary behavior is associated with the desired consequence of this behavior through reinforcements (Skinner, 1938). Reinforcements strengthen the behavior, while punishments work for weakening it. Both reinforcement and punishment can be positive or negative. The notion of positivity and negativity is about presenting or taking away a stimulus, respectively, to change the likelihood of a specific behavior happening. In the case of positive reinforcement, an encouraging stimulus is given to the dog, such as petting. If a dog is exposed to a repulsive stimulus, such as scolding, then it would be the case of positive punishment. Following the same logic, in the case of negative reinforcement, a repulsive stimulus is taken away from the dog. For example, while teaching the sit command, releasing the force exerted on the dog’s bottom helps to relieve it. If the dog is deprived of a pleasant stimulus, then it would be the case of negative punishment, such as ignoring the affection of the dog by intentionally not paying attention to it. To illustrate these concepts more clearly, additional examples are given in the below table.

Table 1 - Behavior Correction Types

	REINFORCEMENT	PUNISHMENT
POSITIVE	Adding pleasant stimulus: Giving treats	Adding repulsive stimulus: Choke collars
NEGATIVE	Removing a repulsive stimulus: Ending physical force on dog’s body	Removing a pleasant stimulus: Ignoring affection of the dog

Modern trainers do not evaluate this system as a reward or punishment. They focus on the right timing of the reinforcement and its effectiveness in the long run (Pryor, 1999). Clicker training is an example of operant conditioning in which positive reinforcement is used with a specific operant. This operant is chosen mainly as a clicker, however, other auditory alternatives or cues serving for other senses might be chosen depending on the case (Pryor, 2010). In the reviewed ACI cases, clicker training with its different methods was preferred to teach the desired behaviors to activate the system. These methods can be described as:

- ***Capturing*** method is for natural, frequent behaviors that are common and observable. Right after the dog performs the behavior without any guidance, the clicker is used to mark and capture the behavior. Then the behavior is reinforced by giving a reward. Clicker acts as an event marker here.
- ***Luring*** method is leading the dog to the desired position with the help of a treat. When the dog takes its position, clicking and rewarding follow that. It is important to fade out the lure during training, otherwise, the dog expects physical indications of a treat to take the desired position (Valentin, Alcaidinho, Howard, Jackson, & Starner, 2016).
- ***Targeting*** method is similar to luring in the leading sense. The dog is taught to follow the trainer's hand or a target object (stick or toy). When the desired point is reached by clicking, and the treating process is completed. (Valentin, Alcaidinho, Howard, Jackson, & Starner, 2015).
- ***Shaping*** as a more advanced method is used for more complex behaviors. Behavior is divided into simpler components to create a sequence, and by reinforcing the dog step by step towards the desired final behavior, the end goal is tried to be achieved (Byrne et al., 2018).

All these methods are advised to be performed with an expert to avoid possible negative emotional effects on dogs, such as frustration, freight, and anger.

Training participation is categorized under the non-participant part in DLOP due to the bias introduced by the incentive given to the dog. The dog's motivation is not to

complete the task to contribute to the research but rather to acquire the reward. The dog performs the task as it is taught by the researcher and does not reflect its own perspective regarding the design in front of it, hence helping little for the iterative development. However, training participation can be chosen for the involvement of the dog user to the study for cases where the factual ability of the dog is needed as in medical detection (Mancini et al., 2015) or assistance tasks (Byrne et al., 2018).

Freedom participation as the second rung of the non-participant part of the ladder only gives the liberation to the dog to accept or refuse to attend to the research (Ilyena Hirskyj-Douglas, Read, & Cassidy, 2015). The researchers choosing to apply freedom participation in their study do not give any incentive to the dog. Without the motivation of any reward, the attendance of the dog reflects their fundamental preference about the study. Even though there is a possibility of interpreting the dog's general idea regarding the study through the dog's observed reactions during the selection of attendance, these interpretations would not be mature enough to feed the iterative process. On the second rung of the ladder, the dog gains a little voice compared to the first rung, yet it still needs to be strengthened to be considered as participation.

2.1.4.2 Participation

The participant part of DLOP starts with the third rung, **informed participant**. Informed rung offers actual participation with the feedback of the dog. While interacting with the design presented to them, dogs contribute to the process by showing whether they are interested, repugnant, curious, hesitant, apathetic, and more. These reactions are observed and interpreted through their body language or with the level of their interaction. Interpreted indications help the researcher to develop alternative iterations (Ilyena Hirskyj-Douglas et al., 2015).

The last rung in the ladder is a conceptual level named **empowered participant**. In this level, a dialogue between the dog and the human designer is created through

technological conversion. All signals coming from the dog such as posture, tail wagging, ear movements, hormonal and electrocardiographic physical indicators, and more are collected and translated to a convention appropriate for human cognition. In return, the reactions of the human are converted and delivered to the dog. It envisions the elimination of communicational asymmetry between these two species (Ilyena Hirskyj-Douglas et al., 2015).

To accomplish the fundamental intents of the ACI field, advancement through the upper rungs of the ladder should be encouraged. One of the purposes of this thesis is to support this movement by highlighting methods that would help reach the informed rung on the ladder. For the studies using training methods, dogs only follow the trained steps to reach the reward and do not reflect their preferences. Going to the upper steps of the ladder, dog is given a choice of involvement to the study or leaving it. It has a control of its own participation, however other than that, if the dog chooses to stay and continue with the study, only performs the trained steps for reaching the reward, as in the first rung of the ladder and does not contribute to the design by sharing its personal perspective with its choices. On the third rung, the opportunity of participating the study truly presents itself. Dog and human designer explore possibilities of interaction together. Preferences of the dog can be observed. With the increased participation of dog, the designers can establish empathy with their users. Established empathy of designers can help them to present more insightful solutions that could help achieving user-centeredness for dogs.

To offer more than freedom participation to dog participants and to move away from anthropomorphism, the focus should be shifted to their natural behaviors rather than imposing human behaviors on them. Common ground for such participation is embodied in play as manifested in the literature (Jørgensen & Wirman, 2016).

Play is a complex phenomenon that is studied thoroughly in animal welfare science. It varies in the definition because its boundaries with exploration and curiosity or with stereotyped behavior are vague. Burghardt (2005) defines five criteria and states

that if these following five criteria can be satisfied at the same time, then the behavior can be defined as play:

1. Play behavior is not fully functional i.e., it is directed towards stimuli or consists of elements that are not necessarily affecting current survival.
2. The behavior of the animal must have one of the characteristics to be recognized as play, 'spontaneous, voluntary, intentional, pleasurable, rewarding, reinforcing, or autotelic' (Burghardt, 2005, p.73).
3. It must be differentiated from the 'serious' behavior of the animal. Without following the usual behavior patterns, it can be an unfinished act or more exaggerated.
4. Animal repeats this behavior, but this repetition is not an exact replica, changing with little nuances and not following a strict order, hence does not turn into a stereotypical one.
5. For an animal to initiate the play behavior, it must be in a good state. That includes not being hungry or thirsty, not feeling discernibly stressed, and not being under the influence of hierarchically more dominant needs such as mating.

As supported by Held and Špinka (2011), initiation of the play is assessed as a welfare indicator.

Play behavior changes inter-species and in the members of the same species depending on the age, breed, and physical features. Depending on the type and duration of the play, it brings long-term benefits such as development in capabilities of the animal and enhancement in physical features, or short-term benefits such as getting informed about the environment animal plays in, personal awareness, socializing with others, and emotional improvement (Held & Špinka, 2011).

Fagen (1981, as cited in Burghardt, 2015) defines three types of play for animals in general. Locomotor/rotational play is performing noticeably large body movements in an exaggerated way, such as running and climbing. Object play is interacting with an object in a playful manner to explore it. Animals typically chose these two types

of play when they are alone. If they are in the accompany of other animals, social play would be an alternative option. It is getting physical with other animals in form of fighting, chasing, rolling together, and so on. There are no boundaries and strict rules for play. All types can be combined and performed in solitary or within a group.

Play offers chances for the exploration of new interactions. A designed artifact in the form of a smart toy that is moving around and emitting auditory or olfactory stimuli for dogs would grab the attention of the dog and a play session starts. In the development of such an artifact, observing the interaction of the animal and making design decisions based on these observations is an option for a designer to choose. However, in such a selection, designers keep themselves out of this exploration session. Being a part of this play and exploring possibilities together creates a chance for direct communication.

In one of their studies, Westerlaken & Gualeni (2016) follows such an approach by designing two different artifacts and starting a playful interaction session with the participant dogs. In these interactions, they use body-storming as a technique to try out different design scenarios directly affecting the iterative prototypes. Motivating the dogs by integrating different flavors to the artifact, they simply start playing. Control of the artifact swifts between the human and the dogs. A triangle of interaction is formed. Dogs interact with the artifact by picking it up, moving it to another location, or ending the session by taking out the treat. Human not only interacts with the artifact by bringing it, modifying it according to the approaches presented by the dog but also interact with the dog by pointing the artifact, or by filling the artifact with new treats and hence giving the clear sign of a new play session is starting. Dogs react to the gestures or attempts at verbal communication by making eye contact or jumping on their laps. By not standing on the side just to observe the process, sharing this voluntary experience with the dogs, and trying to communicate through dynamics of play, the designer explores the term becoming with introduced by Harraway (2008). Designer builds a bridge of communication with her participants and becomes a stakeholder in the design process with the participants, rather than the sole (human)being in charge of the process.

Play creates a shared language between the human designer and dog user by demystifying dogs' preferences through their play behavior. They try out the different affordances that the prototype offers, give honest reactions to the object and to each other's responses in real-time without following a script, and feeding on these, iterative development can be applied by the designer to test out in another play session.

2.1.5 Sensory Abilities of Dogs

The dog users embody different physical and cognitive capabilities compared to human users. Their capabilities shaped with their sensory abilities form the design requirements that the designer tries to satisfy. Hence, it is important for the designer to be informed about the strong suits and weaknesses of the dogs when it comes to their senses.

With an aim to present the characteristics regarding the sensory abilities of dogs, this section is divided into five sub-section covering senses of olfaction, gustation, vision, audition and somatosensory system. Information regarding each sense comes from the animal studies literature.

2.1.5.1 Olfaction

The olfactory capabilities of dogs are really strong. It is a tool for collecting information and communicating. Adult dogs can process more complex odors, to distinguish the ones with minute differences better and have stronger long-time memory regarding the odors they have encountered throughout their lives compared to juvenile dogs (Wei, Zhang, Ma, & Guo, 2017).

Interacting with the odor for dogs happens in two ways either by smelling or sniffing (Kokocińska-Kusiak et al., 2021). According the studies of Kokocińska-Kusiak and colleagues, smelling is an effortless action happening unconsciously, that is

occurring with the natural breathing action. It simply warns the dog about the existence of the stimulus. Sniffing, on the other hand, is a cognitive behavior occurring intentionally. Scanning the surroundings to pinpoint the source of the odor and discriminating it among the other existing odors. The researchers see sniffing a conspecific communication tool (Kokocińska-Kusiak et al., 2021). They find out that areas sniffed by dogs change depending on the gender, however, the action is mutual and both parties collect information. When they are provided with odors from humans and dogs, their physical measurements peak in the presence of a familiar human.

The behavior of the dog encountering a smell and trying to explore it might give a clue about the classification of the odor that is sensed. Dogs have sniffing lateralization (Siniscalchi et al., 2011). They show a right nostril bias by starting the sniffing action using it. If what they have sniffed is familiar or a positive odor such as food, they continue their exploration through the left nostril. If they detect that it is a novel smell, giving a sense of threat, or arousing in a way awakening their adrenaline, then they continue using only the right nostril (Siniscalchi et al., 2011).

Dogs can track a scent by sniffing the ground and following the left-over trail or by air sniffing in the case no trail is available (Kokocińska-Kusiak et al., 2021). Compared to humans, even a small amount of odor concentration is enough for dogs to detect it.

The superior olfactory capabilities of dogs make them candidates for human collaborated works (Fenton, 1992). Service dogs are used for the detection of landmines, explosive chemicals, various illegal drugs. Their ability to detect human odor is used in search and rescue during natural disasters or accidents and in criminal identification. They can distinguish the scent of a specific person in a crowded group of people. Specifically trained ones can find the remains of human bodies below or above ground, even in the water.

From the scent of distinct pathogens contained in human blood and urine, dogs can identify related diseases, even if the pathogens are in very low concentrations

(Kokocińska-Kusiak et al., 2021). They can alert their human companions with diabetes when their glucose levels fluctuate (Lippi & Plebani, 2019), detect a variety of cancers from collected extracts, and even the location and development of specific cancer types (Williams & Pembroke, 1989).

Dogs' ability of human-related odor detection is not limited to the identification of specific individuals or the diseases they have. A study conducted by D'Aniello et al. (2021) shows that dogs can perceive whether a human is feeling happy or fearful through their sweats. In the study, dogs were responsive to the happy state of their human companion, however the peak of their interest was towards the fear condition of humans compared to the happy state.

2.1.5.2 Gustation

Taste sensitivity is related to the number and types of papillae located on the tongue. Activation of these taste-specific receptors in the taste buds realizes the ability of taste (Lindsay, 2000).

In his book, Coren (2005) states that while humans have approximately 9000 taste buds, dogs only have around 1700. Even though their sensitivity is less than humans, the author informs that dogs can still taste sweet, salty, sour, and bitter flavors as humans do.

Dogs, being omnivores, eat both meat and plant matter. However, in the wild, majority of a canine's diet composed of meat and as a result of the evolutionary development of taste receptors particular for meat-related chemicals, dogs prefer food having the flavor of meat (Coren, 2005).

Sugar and several sweet-tasting amino acids stimulate the most prevalent receptors in dogs. Citric acid, for example, inhibits the rate of activation of these sweet taste receptors, giving a feeling akin to sourness in humans (Lindsay, 2000).

According to Boudreau (1989), dogs have no salt-specific taste receptors, according to Coren (2005) interprets it as due to the heavily meat-based salt balanced dietary habit coming from their wolf ancestors, dogs' taste buds are not tuned to salt.

In his study, Boudreau (1989) also discovers that dogs' taste buds respond to furaneol, a chemical contained in many fruits, hence they prefer this sweet flavor.

Several foods might carry health risks for dogs, leading to poisoning. Onion and garlic, ethanol that can be found in alcoholic beverages, paint, mouthwash and in some types of antifreeze, grapes and their dried products, hops used for beer brewing, chocolate and caffeine, and macadamia nuts are some of the examples of such foods (Cortinovis & Caloni, 2016), (Gugler, Piscitelli, & Dennis, 2013). While deciding on a dog's diet, it is a must to consult an expert opinion.

Dogs do not favor the bitter flavors. Thompson explains that because dangerous materials are typically bitter, dogs are particularly sensitive to bitter chemicals, a biologically evolved trait that may have survival significance according (1993, as cited in Lindsay, 2000). This feature is used in the chew-deterrent sprays (Coren, 2005).

Dogs, in opposed to humans, can taste water thanks to the specific taste buds fine-tuned to water, while humans cannot (Coren, 2005).

2.1.5.3 Vision

The retina of a dog contains far more rods, photoreceptor cells sensitive to light and dark contrasts, than cones, photoreceptor cells sensitive to detail and variations in color (Peichl, 1991). The dog's eyesight is more adapted for discerning light and dark, and detecting movement than it is for perceiving color and detail due to the preponderance of rods (Lindsay, 2000).

Through a series of color discrimination trials, a group of researchers discovered that dogs can distinguish dichromatic colors in the blue-violet and yellow-green

ranges (Neitz et al., 1989). The colorlessness was discovered in the greenish blue range. They cannot tell the difference between many other bright colors that people can see, such as red, orange, and green, which dogs probably interpret as tints and shades of yellow or blue (Lindsay, 2000).

Author Lindsay (2000) states in his book that dogs have remarkable night vision and can see in dim light or complete darkness. A particular reflecting surface improves the dog's vision in low-light situations.

The visual perspective of dogs is directly related to the eye height, and hence closer to the ground when compared to people. Height differences across the breeds affect visual perspective and as a result directly affecting the perception of the environment (Miller & Murphy, 1995).

According to the studies of Miller and Murphy (1995), placement of the eyes on the skull is another factor in vision, determining the visual field of view. Compared to the straight-looking eyes of humans, the direction of eyes in dogs is lateral. Due to the positioning of the eyes and the presence of a broad muzzle obstructing a full frontal vision, the average dog has a range of overlap between the right and left eyes around 40 to 60 degrees (Lindsay, 2000). The author compares the binocular skills of dogs to humans. This range offers dogs binocular skills that are good but not quite as good as humans'. In terms of peripheral vision, this is a plus. The typical dog's peripheral vision is roughly 250 degrees, whereas human peripheral vision is about 180 degrees (Lindsay, 2000).

Depth perception is a key feature of binocular vision. Because a dog's binocular vision is limited to a narrow frontal range, only the depth of a small field of vision in front of it can be perceived by the dog (Lindsay, 2000). Miller and Murphy (1995) define a 50 to 33 cm range in front of the dog's eyes for them to see the objects unblurred. If the object gets closer than this, other senses support what is lacking in the vision to distinguish the object. Based on this information, in a designed setting that allows the dog to approach, the boundary can be designated accordingly. If a

visual is to be placed in the blurry region, one should avoid adding details that need to be distinguished.

2.1.5.4 Audition

Dogs are thought to have stronger hearing than humans, and they may be able to hear sounds from up to four times further away than people (Barber, Wilkinson, Montealegre-z, & Ratcliffe, 2020).

One other superiority of dog audition over humans' is that they can hear sounds outside the human range of audibility. Even though estimations change from study to study, dogs can hear ultrasound while humans cannot (Lindsay, 2000).

Another aspect in which the dog's hearing is superior to ours is its capacity to pinpoint the source of distant sounds. With the help of their flexible earflaps, adult dogs can detect the source of sound with exceptional accuracy(Ashmead, Clifton, Reese, & Hadley, 1986).

Thompson states that the tiniest movement of the head toward the stimulation source offers additional distance information. The brain can triangulate and compute the sound's distance using spatial information provided by this shift in the dog's head position relative to the sound. (1993, as cited in Lindsay, 2000).

Dogs' ability of hearing in the ultrasonic range is made use of in dog training via devices using high-frequency sounds. 'Silent' whistle commonly has been employed as a signaling device, particularly for recalling (Lindsay, 2000). Landsberg give the example of battery-powered ultrasonic devices are used for auditory punishment as alternatives (1994, as cited in Lindsay, 2000). Such aversive techniques are not recommended by the experts; however usage of low intensity ultrasound is accepted to be effective in dog training as a way of signaling and managing acquired behavior (Lindsay, 2000).

2.1.5.5 Somatosensory System

Sensitivity to touch varies among dogs depending on the emotional state the dog's in, overall physical health, and previous experiences shaped through learning (Lindsay, 2000).

The skin is the largest sensory organ in a dog's body and accommodates various input specific receptors. There are five different types of receptors which are responding to painful stimuli, chemical stimuli, sensitive to bodily movement and position, to temperature, and to physical changes and pressure. Latter one comprised the majority among them (Lindsay, 2000).

The vibrissae i.e., whiskers, is the source of information for dogs regarding the adjacency to the objects around the face. They are sensitive to vibration and minute movement of air in addition to direct mechanical stimulation (Lindsay, 2000).

Studies conducted with puppies show that feeling of soft objects, like fabrics, have an effect of soothing the separation-related behaviors (Igel & Calvin, 1960), (Pettijohn, Wong, Ebert, & Scott, 1977). In the study conducted by Pettijohn and colleagues, food known by the dog or toys having a hard surface had no influence on the minimization of the distress.

Petting is also found out to be effective for calming distress in dogs, based on the observation of the decrease in heart and respiratory rates following the petting (Gantt, Newton, Royer, & Stephens, 1966). Another group of researchers examined the same phenomenon during the pre-shock and post-shock periods of the classical conditioning, where thanks to petting heart rates of the dogs prominently decreased (Lynch & McCarthy, 1967). Not only the petting but also how it is performed has an impact in stress reduction. Deep muscle type of massage or long and firm caresses from the head to the hindquarters had the best benefits (Hennessy, Williams, Miller, Douglas, & Voith, 1998). Dogs learn to associate soft caressing with positive reinforcement and harsh handling with negative reinforcement (Lynch, 1970).

Communicating through touch is not just one sided. Dogs also convey messages via gently licking on certain parts of the human's body, raising paw while seeking attention or even biting on the leg. Modality of touch becomes a medium for both dogs and humans to express themselves emotionally and understand each other (Lindsay, 2000).

2.2 Welfare of Animals

Humans and dogs have had a strong bond for a long time. The type of their relationship depends on the attitudes of the humans. While some people see their dogs' status below themselves and think they are useful for protection or entertainment, others have a more egalitarian view. They think that their dogs are either equal to themselves or even superior to themselves (Blouin, 2015). People sharing these attitudes cast their dogs as their best friends or a part of their family mostly in the role of a child. Diversity in the attitudes of people's perceptions about their dogs reflects itself in how well they care for their dogs. To satisfy the well-being of their dogs, some people spay and neuter them after adoption. To keep their physical health in order, they take their dogs to the veterinarian appointments regularly and follow up on their vaccinations. On the other side of the medallion, there are people who neglect the care of their dogs for various reasons. This neglective behavior may risk the physical health of the animal. However, the well-being of an animal is not only about its physical state. Animal welfare, as its scientific term, is a concept that cannot be approached from a single direction.

The terms well-being and welfare are quite close to each other and used interchangeably from time to time. Throughout this thesis, while using the terms well-being and welfare, welfare is preferred by making a conscious choice. The reason for this is that well-being is a more individual concept and, when used for people, it refers to the things people do for their personal physical and psychological development with their own preferences. The well-being of dogs, on the other hand, does not come from behaviors performed as a result of individual choices, but

manifests itself as a result of the behavior of the people responsible for caring for them. In the literature studies that is explained in this section, animal scientists focus on the term welfare. In addition to that, the concept of welfare goes beyond the individual efforts and is tried to be improved by taking it under protection with regulations. However, these organizational efforts are out of the scope of this thesis.

Fraser (2008) groups the key points of decades-long discussions about animal welfare into three following major points:

- Animal being healthy and functioning without any physical injury or disease.
- Animal having a positive affective state. In this definition, affective state expresses a combination of pleasant and unpleasant emotions and feelings, such as pleasure, happiness, and pain, along with states like hunger and thirst.
- Animal living naturally, exhibiting natural behaviors in an environment filled with natural elements.

These points have overlapping and conflicting stances. Choosing only one of them and focusing on it would avoid reaching a holistic welfare condition. Department for Environment Food & Rural Affairs collected the points of animal welfare for dogs in its *Code of practice for the welfare of dogs* (Department for Environment, Food and Rural Affairs, 2018) in the following necessities:

- Need for a suitable environment,
- Need for a suitable diet,
- Need to be housed with, or apart from, other animals,
- Need to be able to exhibit normal behavior patterns,
- Need to be protected from pain, suffering, injury, and disease.

Meeting the above-given requirements can help a dog to reach a good level of welfare. Reaching the optimum level in terms of welfare can only be achieved by including the satisfaction of emotional states in addition to these necessities. Disregarding the emotional welfare of dogs might be caused by a lack of knowledge or misconceptions about dogs. One possible reason for that is the humanization of

dogs by their human companions (Rooney & Bradshaw, 2014). Because humans perceive their dogs as their best friends or a member of their family, they assign humanized characteristics to them and predict their behaviors using what they know about themselves. These, however, lack any scientific groundings, even if they turn out to be true. Welfare studies conducted to explore all the related parameters for dogs are mostly performed in controlled settings such as shelters, veterinaries, and laboratories. While they give rich insight about the welfare of working dogs, dogs kept in captivity in shelters, or clinical dogs, a consensus on the features for the welfare of dogs living in domestic settings have fewer studies in comparison. One affecting factor is that the living conditions of domestic dogs vary significantly (Stafford, 2007).

Although physical health-based facts about dogs are explored in detail and put into practice in veterinary science, the emotion-based world of dogs still has a lot of unexplored areas. The living conditions of dogs differ depending on their status such as working dogs are mostly kept in kennels or in training establishments, stray dogs live on the streets, some dogs are kept in shelters waiting to be adopted, and some are taken care of by humans in their gardens or houses. If we focus on the dogs that are living in domestic settings, as in the scope of this thesis, their human companions have varying levels of knowledge about their welfare protection, except for neutering and spaying after adoption and regular vaccinations. In particular, the fact that those living in the house have a relatively simple and boring life can influence their welfare (Stafford, 2007). Since the welfare of animals is directly shaped by the human context in which they live, it is essential to look at the points that will affect their welfare when design studies for this context are intended.

In addition to these, it is worth emphasizing that the dogs selected as the target user group for this thesis are non-clinical dogs. Clinical dogs should be approached with different sensitivity as they are dogs that have been diagnosed and need treatment.

2.2.1 Anthropomorphism and Anthropocentrism

The correct understanding of the capabilities and perceptions of dogs is an important point to ensure the welfare of dogs in a holistic way and to establish a good bond with their human companions (Rooney & Bradshaw, 2014). The welfare of dogs living in domestic settings is shaped by the environment they live in and their human companions. The fact that people see their dogs as a part of their family or as close friends makes it difficult for them to understand that their dogs have different sensory abilities. Inevitably, they humanize them while approaching them or interpreting their behaviors (Rooney & Bradshaw, 2014).

Anthropomorphism is assigning human characteristics or behaviors to non-human beings (Airenti, 2018). Their reality is judged by human capabilities, experiences, and understandings. To test the associated behaviors to dogs, Horowitz & Hecht (2014) run a study with dog owners for the feeling of guilt. In a setup, owners are told to give commands ‘not to eat the treats’ to their dogs. After their non-observational time, while they are out of the room, some of them are informed correctly, and some of them are misinformed about what their dogs had done. Humans believe that when their dogs misbehave, they feel guilty, and have a guilty look followed by behaviors like rolling over on the floor, avoiding any contact with their owners either by turning their heads or hiding behind an object, etc. However, results have shown that these behaviors are dogs’ reactions to the anticipated scolding of their human companions. Even if they have not done anything wrong, they exhibit this set of looks and behavior, to avoid the possible negative treatment or punishment. Hence, they do not reflect the outcome of their guilt, if they have and feel it, they simply respond to the conception of guilt in their humans’ minds by showing instinctive submissive responses (Horowitz & Hecht, 2014).

As the root of technological developments, the computer design, which targets human users primarily, is purely anthropocentric. The design is developed by humans for the usage of humans in accordance with the human factors and improved from the feedback obtained by usability research results conducted by humans (Ritvo

& Allison, 2017). Since field of ACI derived from HCI, when primary users change from humans to animals, methods and approaches have to be altered by integrating the capabilities of animals into the thinking process structuring the design. Otherwise, modalities and perceptions of animals do not align with the features of designed interaction due to human subjectivity.

Horowitz & Hecht (2014) questions the experiments performed with dogs for pointing gestures of humans. It is interpreted as dogs treating this gesture as a visual cue; however, the researchers speculate about the possibility of olfactory senses of dogs might overweighing. They claim that olfactory cues coming from the armpits when the humans raise their arms might be more informative for the dog. This example shows that even though researchers studying with animals try to avoid anthropomorphizing their subjects and implementing anthropocentric approaches, it might be inevitable due to the limitations of human capabilities, as in the detectable visual cue for humans and possible olfactory cue detectable for dogs in the aforementioned study. In such cases, an approach could be questioned and be challenged by the implementing researchers by discussing the possible alternative reasons of the dog participant's behavior by taking dogs' sensory capabilities into consideration.

2.2.2 Welfare Issues

Fear and anxiety in dogs might manifest themselves due to a variety of reasons and directly affect their welfare negatively. Behavioral and physiological signs of fear and anxiety in dogs studied by Ballantyne (2018) are summarized and given in Figure 2. During the development of design solutions, stimuli for the interaction should be carefully handled in order not to trigger possible welfare issue.

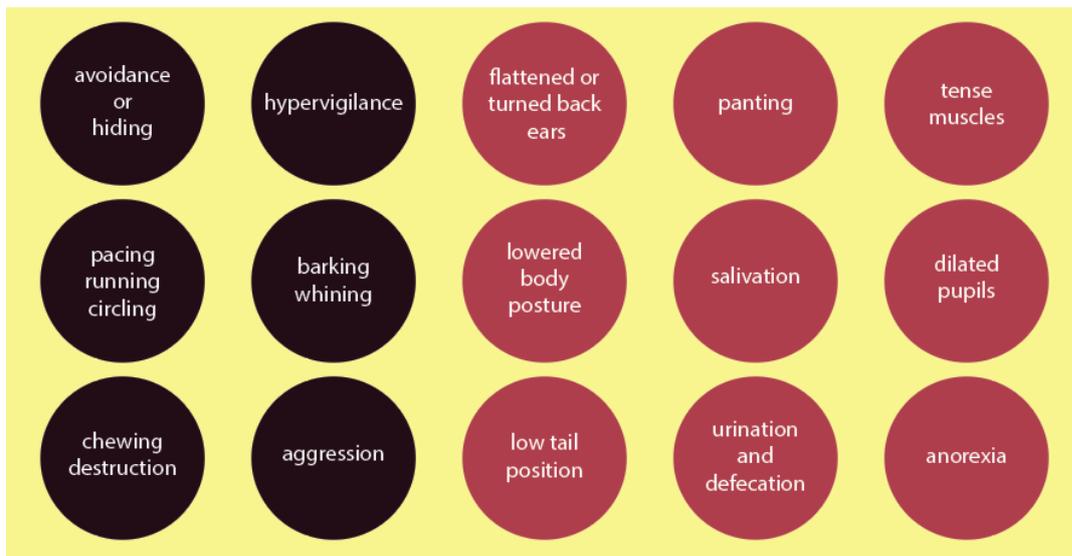


Figure 2 – Signs of Fear and Anxiety

Behaviors triggered in dogs when left alone at home by their owners vary. Behaviors such as vocalization, house soiling, object traumatization are the issues observed especially when dogs are alone at home, while confinement distress and noise aversion can be strengthened by being alone, yet they are also observed separately. Dogs with these issues may show similar signs. These issues can also occur simultaneously (Hubrecht, Wickens, & Kirkwood, 2016).

Dogs with separation anxiety, confinement distress, and noise aversions may present with injuries from escape attempts or destructive behavior, such as fractured crowns, broken nails on forepaws, and cuts and abrasions around muzzle, nose, or paws (Ballantyne, 2018, p. 8).

2.2.2.1 Separation Related Behavior

Dogs being alone at home, separated from the human companion, which takes place quite a lot in the daily routine of house dogs, causes dogs to exhibit certain abnormal behaviors.

Since humans are not at home, they might not easily recognize these behaviors and the impact of these behaviors on the welfare of their dogs. These behaviors are treatable; however, they must be detected first and assessed from a non-human-centered point. It gives an important opportunity for the implementation of design solutions.

Studies conducted with nonclinical dogs show that when they are left alone at home, they display different separation behaviors. Even though homogeneity is not observed throughout the studies, there are certain behavior clusters.

Separation behaviors of clinical dogs might be the reflection of different concealed emotional states that could be grouped under three categories (Palestrini, Minero, Cannas, Rossi, & Frank, 2010):

- **Discomfort response** in form of lip licking, yawning and paw raising due to distress,
- **Fearful response** manifesting itself in increased motor activity and escape, or in behavioral inhibition,
- **Anxious response** expressing itself with high attention to the surrounding, vocalization and hesitant exploration.

Results of the study conducted by Lund and Jørgensen (1999) with the sample group of not only puppies, but also older dogs show a chain of problematic behavior in the case of separation. This chain of behavior is composed of **exploratory behavior, object play and destructive behavior**. Their results indicate that dogs act out not because of disobedience or boredom but rather due to frustration. Their sensibility to different stimuli may increase resulting in high arousal. To find a satisfying stimulation, they begin to explore their surroundings which turns into an object play. However, some components of predatory behavior accompany this play and due to their aroused state might end up in destructive behavior applied on the object of play.

Another article inspecting the reasons of anxiety, fear and phobia in domestic dogs written by Ballantyne (2017) explains such **destructive behavior** as targeted at exit

locations of the house. Researchers interpret the damaging behavior of highly affected dogs as an effort to re-connect with the human companion or escape from home.

In a study conducted with puppies, majority of the group displayed **inactivity** behavior such as sleeping or resting (Frank, Minero, Cannas, & Palestrini, 2007). This behavior was discernibly lower during the first 15 minutes of the observation time and increased over time. Dogs participating the study had different levels of freedom at home. Some were kept in crates; some had limited access to rooms of the house and others roamed freely at home. Even though there are opposing opinions about crate usage for dogs in domestic settings, results of the study show that caged puppies displayed similar behaviors regarding locomotion and inactivity compared to the ones that are roaming freely in home. Following the inactivity, vocalization, exploration, grooming, locomotion, yawning, lip licking, and scratching were observed for shorter time periods.

When left alone at home, while clinical dogs show such distress and anxiety-based responses, nonclinical dogs mainly exhibit **passive behavior** in comparison. (Scaglia et al., 2013). They expressed behaviors such as vocalization or being alerted to the surroundings but for shorter periods than clinical dogs. Scaglia and her colleagues (2013) state that expressing such inactivity is reasonable for an alone dog who is in a relaxed emotional state in a familiar environment. Not being accompanied with any other animal or human may decrease the possibility of physical activity and play, and a familiar environment does not offer any new information to be explored.

A study examining how the dog perceives separated time and whether the length of that time has an impact on dog welfare showed that the difference in the length of time alone did not lead to any behavioral changes in passive behaviors (Rehn & Keeling, 2011). Changing behavior is observed with the return of the human companion. The dog expresses exaggerated welcoming gestures, increased physical activity, and a high level of attention. Even though it cannot be distinguished from the observed behavior and cardiac measurements whether they perceive the passage

of time and missing stimuli during that time until the moment of reunion with the human companion, it clearly indicates that they are affected by the time spent apart. If the human companion does not compensate for this lack of stimulation, repeated solitude due to separation may create welfare ramifications on dogs.

2.2.2.2 Noise Aversions

The exaggerated physical reactions of dogs to sudden and loud noises are called noise aversions. These physical reactions can manifest as trembling, freezing, panting, social withdrawal, pacing, salivation, urination, defecation, destruction, hiding, crouching, and escape behaviors (Blackwell, Bradshaw, & Casey, 2013).

Triggering sounds for dogs could be fireworks, engine vehicle sounds, or gunfire (Blackwell et al., 2013). Conditions such as lighting, overcast weather, rain, and wind accompanying the thunder creates expectation of noise in dogs and this expectation itself might be triggering.

Human companions can observe these reactions when they are with their dogs. If dogs are alone at home, they might react more intensely, similar to how they would react to separation (Ballantyne, 2018).

Although it is not possible to completely isolate the dog from triggering sounds at every moment of daily life, it can be helpful to encourage the dog to stay indoors where they can stay away from these sounds as much as possible, by not taken them out in bad weather conditions or in conditions such as firework or gunshot in order to minimize the sound intensity (Ballantyne, 2018).

2.2.2.3 Confinement Distress

When some dogs go into a small, confined space, they show anxiety. This distress shows itself in crates or kennels. Dogs with confinement distress display intense

behaviors damaging the crate bars with their mouth or paws trying to escape it (Ballantyne, 2018).

If the human companions force their dogs to enter such small places, the action itself could become traumatic for dogs. Intensity of the reactions they display might increase (Ballantyne, 2018).

If the dog experiences only confinement distress, being alone and separated from their human companions might be tolerable for them. However, if the dog experiences other welfare issues such as any of the separation related behaviors or noise aversions, then the reaction they display might get stronger (Irimajiri & Crowell-Davis, 2014).

If the dog does not damage its crate or leaves physical evidence as in the case of house soiling or object traumatization, it would be really hard to detect the issue for the human companion. Observing the home-alone dogs via cameras is one of the most preferred solutions (Ballantyne, 2018).

The distress and dog's reactions to it continues until the place offered to them by the human companion is introduced to the dog as a safe area and dog voluntarily gets into the area. These areas could be crates, kennels or rooms of the house dedicated to this purpose. Alternative solutions could be changing the size of the confined space or restricting some areas of the house (Irimajiri & Crowell-Davis, 2014).

2.2.2.4 Obesity

Obesity can lead to physical health issues. In addition to that, natural behaviors may not be performed due to physical restraints coming with obesity, hence creating psychological issues. Following challenging diets for weight loss might create disturbances in the emotional state of the dog. Food and treats used for rewarding are an important source of motivation for dogs. Overusing of these might end up in obesity cases (Rooney & Bradshaw, 2014).

2.2.2.5 Pedigree Dog Breeding

Pedigree dog breeding creates critical welfare issues. Some of the breeds experience issues in locomotion and breathing because of their physical extremities (Stafford, 2007). These create not only setbacks in the performance of daily activities but also in play sessions, which is another important motivational source besides food. Some breeds have hereditary negative personal characteristics, putting them in a disadvantageous position for adoption or creating ramifications that would eventually end up in returning back to the shelter (Rooney & Bradshaw, 2014).

2.2.2.6 Dog Training

Dog training is a term that is applicable not only for working dogs but also for dogs that are living at homes as companions of humans. Different training techniques are explained in Section 2.1.4.1. Using positive punishment technique for training, especially, adversely affect dogs and changes the emotional state of dogs negatively. They can create long-lasting physical and psychological effects (Rooney & Bradshaw, 2014).

These welfare issues observed especially for the dogs living at homes can be defined as the real needs for dogs to be satisfied for them to achieve a full welfare state. Design solutions can be helpful in these areas.

2.2.3 Strategies for Welfare Improvement

One of the most important factors in improving the welfare conditions of dogs is to strengthen the bond between the human companion and the dog. This can be a primary aid as it would increase the adaptability of the dog to the human and the domestic environment even before the welfare problems are started to be observed.

Drug-induced treatments carried out with specialists require a separate area of expertise and are beyond the scope of this thesis. However, nonpharmaceutical treatments existing in the literature can be integrated into design solutions and help the dog to overcome the welfare problems.

These methods can be generalized as behavioral management. The methods in this context are grouped as modifying the environment to increase the dog's comfort, modifying the dog's interactions with its human companion and its environment, and modifying the behavior to improve the dog's reactions in distress.

2.2.3.1 Promoting Dog-Human Bond

Dogs living in homes are strongly bonded to their human companions. Their routines of eating, going out for toiletry and playing apart from solitary play depend on their human companions. Positive interaction between them makes both parties feel emotionally fulfilled thanks to the released hormones (Odendaal, Meintjes, Technikon, Africa, & Africa, 2003). Adaption to their environments, especially after adoption from shelters, streets, and other neglected homes makes it easier with the human at home. When humans leave home for work and are absent for a significant portion of the day, dogs staying alone at home experience issues and exhibit certain separation-related behavior (Irimajiri & Crowell-Davis, 2014).

2.2.3.2 Modifying the Environment

The difficulty of adaptation in the new living area of the dog may be a factor in experiencing or increasing some welfare problems. In this case, it is necessary to offer the dog a living space where it can be comfortable. The message should be given to the dog that it is safe in its environment to comfortably rest, eat and move around (Ballantyne, 2018).

A crate or a dog-specific room can be offered to provide personal space for dogs. However, this place should be introduced and accustomed to the dog step by step, the dog should be able to enter it willingly and not be forced in any way (Sherman & Mills, 2008).

This area can be arranged to reduce negative sound and light effects. To be able to soundproof the area, acoustic precautions can be taken. Black-out curtain type solutions can be preferred to regulate the light effect when desired (Ballantyne, 2018).

White noise or music can be used in addition to isolating acoustic solutions to assist with triggering sounds. The dog's tolerance should be observed in these sound uses, and care should be taken not to turn them into new triggers (Ballantyne, 2018).

2.2.3.3 Modifying the Interactions

Modifying the dog's interactions with its human companion and the domestic environment can be helpful especially with the welfare issues from separation.

In Section **2.2.2.1**, I have mentioned that the moments when people leave the home or return to the home, and the first time immediately after leaving the house are the primary triggering periods in problems caused by separation. For these time periods, it is important that the routines of leaving home and returning should be kept as short as possible in order not to attract the attention of the dog. Just before leaving the house, events where the human companion interacts directly with the dog, such as playing, training or taking for a walk, should be avoided and time of these events should be planned accordingly (Sherman & Mills, 2008).

Creating interaction opportunities that the dog can engage in from the moment the dog's loneliness begins at home would help the dog to ease into this period (Ballantyne, 2018).

After returning home, human companions should be tolerant of the abnormal behavior the dog may have exhibited, such as house soiling or object traumatization. Showing a vocal or physical reaction to the dog would only increase the dog's stress and would not prevent the repetition of these unwanted behaviors (Ballantyne, 2018). The good bond that is tried to be maintained between the dog and the human companion would also suffer.

There is data in the literature that some human companions justify these punishment reactions with the "guilty" gaze of dogs (Horowitz & Hecht, 2014). However, as explained in Section 2.2.1, the dog's sense of guilt and what people interpret as the guilty gaze is not an attitude that dogs understand that they have done something wrong and take action against it, but a defensive appeasing behavior shown towards the negative reactions of the human companion.

2.2.3.4 Modifying the Behavior

Strategies for changing dogs' behavior are based on altering the dog's association with things to which it reacts negatively. These strategies can be set up for different triggers such as the absence of a human companion, unfavorable sound and light conditions.

One of the fundamental methods mentioned in the literature is to distract the dog and direct its attention and interest to something different (Ballantyne, 2018). This should be done shortly before the event for a trigger that is known to occur, such as when the human companion leaves home, or at a time directly following the event for an unknown trigger such as firework (Sherman & Mills, 2008). A long-lasting treat is one of the suggestions. While the dog is dealing with a treat that it likes to taste, it is expected that dog's focus shifts to the treat and its emotional state would improve. This is an example of the classical counterconditioning method described in Section 2.1.4.1. The feeling of uncertainty and anxiety of dog due to the negative triggering

effect are alleviated with the positive effect coming with a soothing motivational source, like treats or playful interactions.

To reinforce the dog's relaxation, human companion can give the dog a small treat when the comfort is observed. Involvement of experts for evaluation of the current situation of dogs and guidance based on these evaluations would be the safest way for application, repetition and stability of these methods (Sherman & Mills, 2008).

Until the involvement of experts, it is important to observe the dog's reaction for the methods used. If the effect of the interactions on the dog is observed to be relaxing, human companions can continue using the methods. If no relaxing effect is observed, alternative methods should be tried, and immediate expert help should be sought.

CHAPTER 3

METHODOLOGY

The main goal of this thesis is to inform and guide designers about designing for dog users. However, while developing design solutions that will enhance the welfare of the primary user, adopted dogs, the important point is to provide user-centeredness by incorporating the perspective of dogs into the design process. Considering these purposes, I structured my thesis in two stages.

The first stage is the literature review regarding dogs. It is necessary to understand the general philosophy of the design studies for animals, to see the trends in the studies developed for dogs, and to realize the deficiencies in the applied approaches and practices. While targeting dogs as user for the design, the differences of dogs perceiving the world should be reflected in the design.

The second stage is the field study part, comprising interviews. For a design process targeting dog users, the contribution of the dog experts would help to understand the features of the dogs correctly and hence would help to increase the suitability of the design decisions for dogs. Regarding the home life of the adopted dogs, which is the selected context for design, the design decisions will be based on more solid foundations with the insights gained from the experiences of people who had been through this process.

With the insights obtained from the results of these stages, I created a guidance that designers can benefit from, in Chapter 5. In Figure 3, structure of the methodology is given by matching the sections of this thesis with the research questions explored.

RESEARCH QUESTIONS

How can designers be guided in designing for improving of dog welfare?

1. What are the design requirements for designs aimed to improve welfare of dogs in domestic settings?
 - a. Which interactional characteristics of dogs should be considered by designers to center dogs in the design process?
 - b. Which design parameters are effective for improving welfare of dogs in domestic settings?
2. Which considerations should be taken into account in the design process for designing for dogs?
 - a. What kind of a process should be planned for research and design phases to include dogs' perspectives?
 - b. Which differences of dogs compared to humans should be paid attention to?

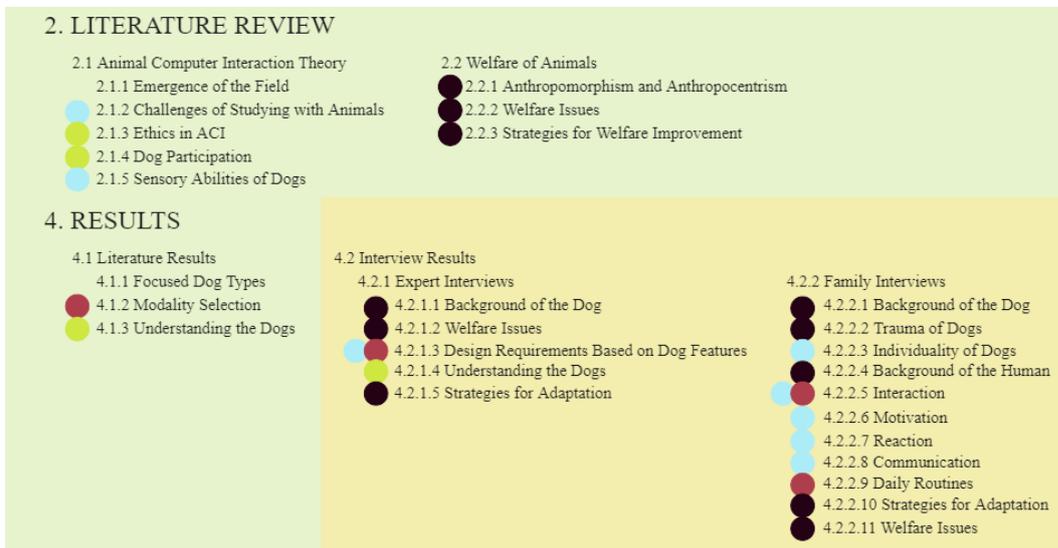


Figure 3 - Methodology Structure

3.1 Literature Review

At the first steps of the literature search, I started with the keyword **design for animals**, since it is the main purpose of this thesis. The literature driven by this keyword, the one that is focusing on designing for animals, was the **Animal Computer Interaction** field. Another keyword, obtained from the design for animals is **multispecies studies**. It deals with inter-species research, however, does not focus on the design aspect. After reaching the ACI field, I have started scanning the published articles in this field. Since the field is a relatively new one, starting in 2011 with its manifestation, my main aim was to discover the certain trends emerging in the field. After examining the articles of the field, I have designated three themes for more detailed review. These themes were **Theory**, **Methodology** and **Interaction Case Studies**.

As two of the main goals of this thesis are user-centered design and welfare improvement for dogs, ACI field was not informative enough to obtain the related insights. In this stage, I have started searching for additional information from animal studies field. For the sake of user-centeredness, I have search for **the physical and behavioral characteristics of dogs** from animal behavior and veterinary literature to identify and understand the characteristics of dogs. While searching for physical properties, **senses of dogs** were used as keywords. To get acknowledged about the other goal, I have used the keywords **animal welfare** and **dog welfare**. By adding the insights I have obtained from these additional examinations, I have enriched my review under the theory and methodology themes that I have designated after the first review of the ACI literature. Flowchart of the main keywords followed during literature review are given in Figure 4.

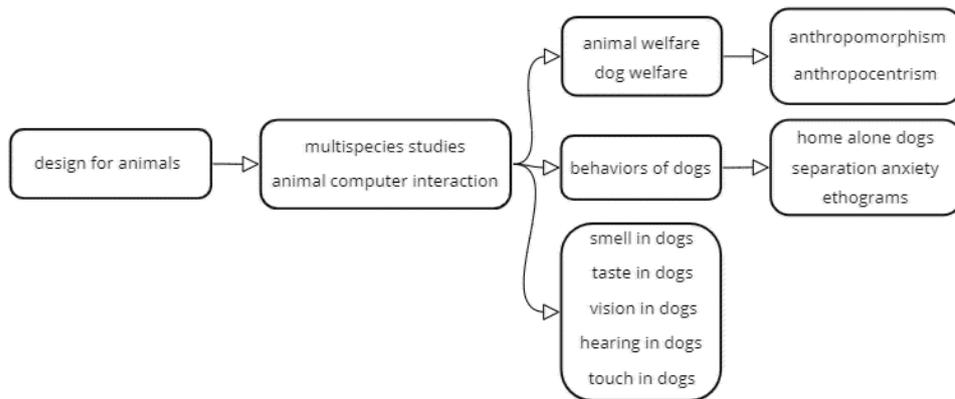


Figure 4 - Keywords of the Literature Review

The theme of **interaction case studies** was created entirely from the ACI studies. While creating this part, I have systematically filtered and examined the Animal-Computer Interaction International Conference proceedings. As of 2016, the 3rd year of the conference, proceedings began to be published. By examining all the articles published between 2016 and 2019, I have specified the animal groups targeted by the studies. According to this specification, I have sorted the articles for three target groups, namely dogs, other species, and animals in general. Number of studies for these three groups for each year is given in Figure 5 below.

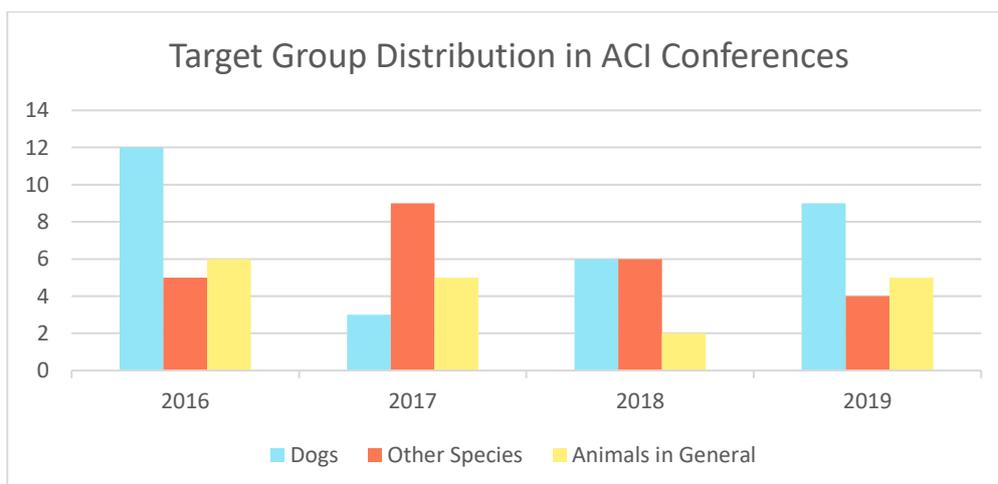


Figure 5 - Target Group Distribution in ACI Conferences

After sorting out the target groups, I have focused on the studies specialized for dogs. Because it is my main motivation to end up with guidance for designers about dogs. I have created the following format, Table 2, to gather the information that I have obtained from the reviewed articles.

Table 2 - ACI Case Study Format

Type	Study	Type of Interaction	Physical Design Parameters	Features of the Animal	Behavior Sense-Making	Type of Participation	Source

While creating the table format I have used the following logic given in Table 3 below:

Table 3 - ACI Case Study Grouping Rationale

Grouping	Aim of the Grouping
Type	What are the main trends in determining the technology?
Study	System: Which technological components are used for the aimed interaction? Aim: What is aimed to be achieved with designed interaction?
Type of Interaction	Using which modalities participant species interact with the technology?
Physical Design Parameters	Which physical design parameters have an effect on the determined interaction modality?
Features of the Animal	Which anatomical and cognitive features of the participant species have an effect on the designed interaction?
Behavior Sense-Making	Which methods are used to assess the interaction of the animals?
Type of Participation	Up to which level target species participate to the study?

Part of the literature review, where the insights of the studies are collected in the described table format is presented in Appendix A - Type of Technologies Studied in the ACI Literature.

After analyzing the findings of the case studies, I have deduced four themes. Among these themes, level of participation, behavior sense-making and physical design parameters were common to all reviewed cases. Level of participation and behavior sense-making shape the design of the research. Physical design parameters affect the scenario of interaction. Medium to be used and modality for the occurrence of interaction co-develop with the chosen parameters. The fourth theme, playful interaction, focuses on the play behavior of dogs. It is a promising common ground for humans and dogs to communicate and explore new types of interaction. It fits the purpose of integrating perspective of the animals to the design process, and that is why deserves a dedicated weight in the acquired results.

Diversity in animal kingdom reflects itself in the conducted studies and studies with various species such as pigs (Alfrink, Copier, Lagerweij, & van Peer, 2014), elephants (French, Mancini, & Sharp, 2017a), gorillas (Gray et al., 2018), and domestic cats and dogs are performed. As deliberated in the introduction chapter, the scope of this thesis choses dogs as the target group, hence while investigating the case studies in the ACI literature, I focused on the studies having dog users. Even though there are prominent studies of ACI field conducted with different species, specifically cats and gorillas, I have not included them in the case review because main aim of this theses is to create a concise information cluster specifically for dogs to create a guidance for the designers.

The multispecies study examples in the literature helped me understand the diversity of studies developed with animals. However, these studies were not concentrated in the field of design. The objectives of the ACI field, which focused on the field of

design, and the studies carried out in line with these objectives were much more informative in designing for dogs compared to all other fields. However, when I examined the case studies in the field, I found that the emphasis and practices of dog-centeredness in the studies were missing. To address this shortcoming, I decided to conduct a study that directly informs the designer about providing user centrality for the dog user. In this study, in order to ensure user-centeredness, learning the dog characteristics by the designer and informing the designer about the design requirements that can be evaluated within this scope in the current field studies were the primary steps. By limiting time period and medium of publication as the main conference of the ACI field, I have gathered the design requirements from the filtered cases. Since the information I obtained from the literature was not sufficient for the specifically determined thesis context of the adopted dog and home life, I conducted interviews with animal behavior experts and families who have adopted dogs. Since the adoption process and the issues encountered are long-term experiences, instead of observation, I preferred interviews where dog families could share their experiences retrospectively.

My literature review studies fundamentally consist of theoretical research and case study reviews. Theoretical research includes the ACI field, animal behavior and veterinary science fields and has been presented in Chapter 2. The case review section covers only the studies conducted in the ACI field and the findings are shared in Chapter 4.

3.2 Interviews

I planned the field study part of my thesis consisting of interviews in two groups (approved by the Human Subjects Ethics Committee with protocol number 358-ODTU-2021). The purpose of the interviews was to obtain detailed information about the home life after the adoption, which is the context chosen while creating the guidance that will help the designers. To that end, I identified two groups to

interview, animal behavior experts and dog owners, hereinafter referred to as dog families.

In a study designed for dogs, it is an important step to convey the opinions of experts to designers in order to understand dogs correctly. Through my interviews with animal behavior experts, I aimed to gain useful input from the experts' vast knowledge of dogs for the specific use concept on which the designer would focus.

The semi-structured interviews I designed for this aim consist of two stages. For the first stage, I go over the written questions, and for the second stage, I support my questions using visual probes. Before starting the stages of the interview, I have briefly explained the aim of my thesis to the experts.

The first stage includes questions for the following purposes:

- To define the welfare of dogs, to understand the factors that affect the welfare state.
- Understanding the impact of the dogs' pre-adoption background, and possible past traumas, on their behavioral traits
- Understanding the factors that affect the adoption of dogs
- Understanding dogs' adaptation to the home environment after adoption and their behavior towards different actors
- Understanding the disorders in dog behavior and learning how to communicate in such situations
- Learning to interpret dogs' behavior
- Understanding how the relationship between dogs and technology is perceived by animal behavior experts

In the second stage, I aimed to learn how to interpret dogs' interaction preferences, behaviors, and reactions to different stimuli using three different visual aids.

- 1st visual aid, the perceptual map, aims to categorize possible stimuli for a dog in the house as positive and negative.

Perceptual Map

	Vision	Sound	Touch	Smell	Taste	Kinesthetics	Other
+							
-							

Intensity of light
Color
Shape

Music
Lighting
Voice of the owner

Texture
Hardness
Temperature

Being yanked away

Figure 6 - Perceptual Map

- 2nd visual aid, the body map, illustrates the names of a dog's body parts. Using this image, I got the opinions of experts about the body parts that dogs will react positively or negatively when touched, and which parts of their bodies the dogs use while interacting with any object.

Body Map

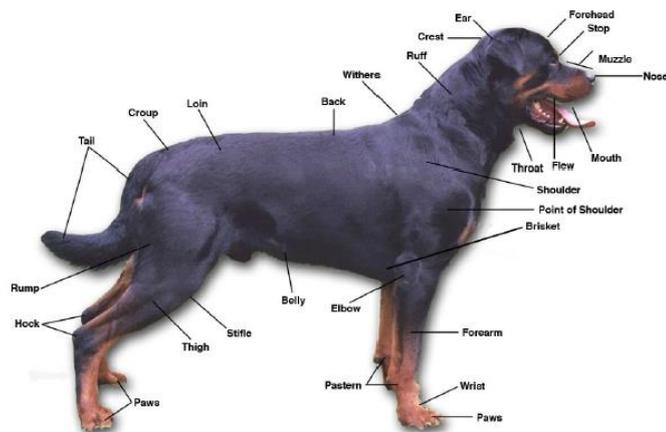


Image Source: www.caninet.com

Figure 7 - Body Map

- 3rd visual aid, the behavioral map, consists of two non-academic ethograms showing the meanings assigned to the body postures of dogs. Through the discussion of the accuracy of these visuals, I questioned how experts understand dog behavior based on their body language.

Behavioral Map

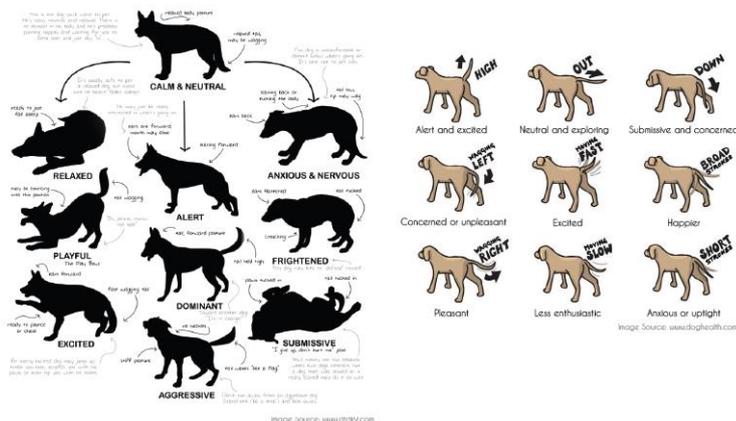


Figure 8 - Behavioral Map ([Dog to English Translation Chart], n.d.), ([Dog Tail Translation], n.d.)

In the group of animal behavior experts, I interviewed two people. Both of these experts specialize in dogs. One has a Ph.D. in animal behavior and welfare, which she carried out after veterinary training. She continues her studies as an academician working in this field. The other specialist specialized in dog training and rehabilitation and dog behavior problems after veterinary training. He has a facility dedicated to the training and behavior correction of dogs.

I had face-to-face interviews with these experts for approximately an average of 1 hour and 20 minutes. I transcribed verbatim the audio files I had recorded during the interviews after taking the consent of the participants. Due to the small number of experts I had interviewed, I could not analyze the data thematically. I have examined the collected data in relation with the themes I obtained from the thematic analysis of dog family interviews. I have followed a narrative approach while presenting the results in Section 4.2.1.

Questions and probes used in the interviews of dog behavior experts are given in Appendix B - **Interview Questions and Mindmap for Animal Experts**.

My second sample group for the interviews was dog families. Since the specific context for the guidance in this thesis is improving the welfare of adopted dogs living in domestic settings, I wanted to benefit from the first-hand experience of dog families who have been going through this process.

For this purpose, I prepared a two-stage semi-structured interview for dog families, similar to the one I conducted with animal behavior experts, the first stage having the written questions to be followed and the second stage questions are presented with the help of visual probes. Before starting the stages of the interview, I have briefly explained the aim of my thesis to the dog families.

In the first stage, I asked questions for the following purposes:

- Getting descriptive information about the personal features of dogs, such as gender and age, and the pre-adoption life of the dog
- Exploring the human companion's history of raising dogs
- Understanding experiences in the adoption process
- Understanding the behavior of the adopted dog after it is brought home
- Understanding the adopted dog's interaction with actors in the home environment
- Understanding how dog owners perceive the relationship between dogs and technology
- Understanding the experiences that dog families would like to share with the people who would like to adopt a dog

In the second stage, different from the expert interviews, I have used two visual aids. These are common with the ones that I have used for the expert interviews, however, while using them I have asked questions specific to the dog they have adopted. While using the explained below visual aids, I have asked the families to share their

experiences and observations retrospectively. I did not ask for them to get prepared for anything prior to the interview.

- 1st visual aid, the perceptual map, aims to categorize possible stimuli for the dog in the house as positive and negative.
- 2nd visual aid, the body map, illustrates the names of a dog's body parts. I asked the dog families to show which body parts they touch to interact with their dogs and classify them as positive or negative according to their dogs' reactions. In addition, I asked while exploring what body parts their dogs use.

In the dog families group, I interviewed 9 families and collected data about 11 dogs. Here, the concept of the family describes the human companions of the dog. I conducted some of the interviews face-to-face and some over the internet due to COVID-19. For the participants that I could not meet face-to-face, I projected the visual probes to them by screen sharing and asked them to voice their opinions. I recorded audio files in my face-to-face meetings and video files in my online conversations after taking the consent of the participants. I transcribed verbatim all of the audio and video recordings. The average duration of the interviews was approximately 2 hours 10 minutes for families with two dogs and 1 hour 20 minutes for families with one dog. The following table, Table 4, shows the characteristics of the dogs interviewed for. The names of dogs are also encoded like the names of their human companions:

Table 4 - Participants of Dog Family Interviews

Dog	Human	Age of Adoption	Gender	Breed	Other Animal at Home	Background
D1	H1&H2	3 years old	Female	Mixed	2 cats	Shelter
D2	H1&H2	2 years old	Female	Mixed	2 cats	Re-homed + Open shelter
D3	H3&H4	1.5 years old	Male	Pitbull +Labrador mixture	-	Open shelter
D4	H5&H6	3.5 years old	Female	Maltese terrier	-	Re-homed

D5	H7	2 years old	Male	Golden-Husky- Border Collie Mixture	1 cat	Open shelter
D6	H8	3 months old	Male	Cocker Spaniel	2 dogs in the garden	Veterinary
D7	H9	9 months old	Male	Golden Retriever	3 cats	Re-homed
D8	H10	3 months old	Female	Border collie mixture	-	Shelter
D9	H11&H12	9 months old	Female	Cocker spaniel mixture	-	Shelter
D10	H11&H12	1 year old	Female	Pitbull mixture	-	Street
D11	H13&H14	3 months old	Male	Golden Retriever	-	Veterinary

Outputs of two visual aids obtained from the face-to-face dog family interviews are given below by deleting the name of the participant.

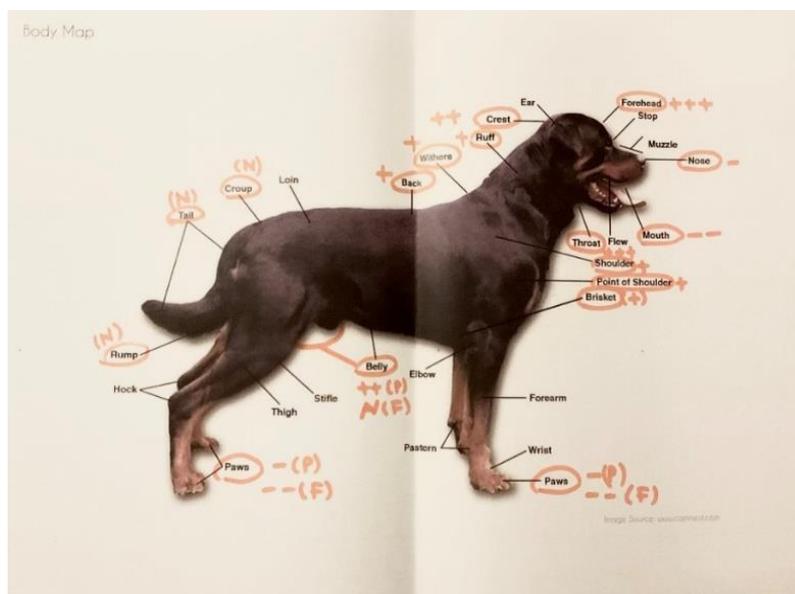


Figure 9 - Example of the Body Map from the Dog Family Interviews

Perceptual Map						
Vision	Sound	Touch	Smell	Taste	Kinesthetics	Other
	- İkiyaz, canlı sesler vib. sesleri	- Halk - Yunusca, yığışlar - Rolar karkınlığı - Yaşat	- Yemek kokuları	- Fırta, karnayus - Çips	- Kasma	- Sana, kurtulu maklıması - Tama ve gıyılar (kama ve fıkılar) - Tazuna kokuları
- Kamera farklı çakıms	- Süslüce Ses - Kapa, adı	- İslamık		- Yayıllık		- Pıncık - Difer karnayus - Tazuna - Tazuna ve Siyahın kokuları
Intensity of light Color Shape	Music Lightning Voice of the owner	Texture Hardness Temperature		Being yanked away		

Figure 10 - Example of the Perceptual Map from the Dog Family Interviews

Questions and probes used in the interviews of dog families are given in Appendix C - **Interview Questions and Mindmap for Dog Families.**

After the in-depth interviews with dog families, I conducted thematic analysis according to the transcriptions I made.

Thematic analysis is a method for reaching repeating patterns within the collected data of the study through examined and generated codes (Braun & Clarke, 2006). The method comprises six phases of data familiarization, initial code generation, initial theme creation, initial theme refinement, final theme creation, and production of the final report (Braun & Clarke, 2006).

For the first step of data familiarization, I have read my transcriptions a couple of times by highlighting and taking notes of the parts that would lead to groups for the initial coding step. Then, to form the codes more systematically, I have used Air Table, an online spread-sheet to collect all the responses I have received during the interviews and create columns for the level of coding. Air Table, similar to the working logic of Excel, was convenient for me to create tags and sort them. While structuring the collected data, I have initially created tags for participants and questions. Then, I have gathered each answer of each participant as textual raw data under the related question and matched it with the participant tag. Based on these

raw data, I have formed three columns for coding, namely Category, Level 1, and Level 2. From general to specific, Level 2 consists of a summarized and interpreted data set of raw data, Level 1 extracted code based on Level 2, and finally, Category is the emerging theme based on the codes in Level 2. With the structure I have formed in Air Table, I have filled out the Level 2 column and by iteratively searching for the initial codes created the content of the Level 1 column. Based on the results of the initial coding, some distinct patterns emerged, and using these patterns, I have created the initial themes under the Category column. By iteratively reviewing the initial themes, I have tried to decide on their direct relevance with the design guidance that I would like to create. This iteration led to the refinement of the initial themes and designated the final structure of the themes. Using final themes, I have created a thematic map of my analysis. Figure 11 presented below, contains a screenshot of the tool I used for coding, Air Table, for the initial theme refinement phase.

Question	Answer	Category	Level 1	Level 2
Q4. Köpeğinizin cinsiyeti nedir?	Dişi.	Individuality	Gender	Dişi
Q5. Köpeğinizin cinsi nedir?	Görüntüsü küçük bir "Bor...	Individuality	Breed	Küçük kurma ırk
Q6. Köpeğinizi nereden sahiplendiniz?	Şöyle, Çanakkale'de Biga ...	Background	Adoption from shelter	Bannaktan şehir değiştirenle...
Q7. Köpek sahiplenme kararını nasıl aldınız?	Ben hep küçüklüğümden...	Background	Experienced adopter	Sahiplenen, geçmişte banna...
Q7. Köpek sahiplenme kararını nasıl aldınız?	Ben hep küçüklüğümden...	Adoption	Features of the house	Sahiplenenin tek kriteri köp...
Q7. Köpek sahiplenme kararını nasıl aldınız?	Ben hep küçüklüğümden...	Adoption	Reasons for adoption	"Hayatımda boşluk oluyor k...
Q7. Köpek sahiplenme kararını nasıl aldınız?	Ben hep küçüklüğümden...	Adoption	Adoption criteria	Sahiplenenin tek kriteri köp...
Q8. Köpeğinizin sahiplenme öncesindeki haya...	Var. Şöyle, tuvalet eğitimi...	Background	Rehomed dog	Tuvalet eğitimi ve koğuğa ç...
Q8. Köpeğinizin sahiplenme öncesindeki haya...	Var. Şöyle, tuvalet eğitimi...	Trauma	Mistreatment	Sahiplenme sonrasındaki fiz...
Q8. Köpeğinizin sahiplenme öncesindeki haya...	Var. Şöyle, tuvalet eğitimi...	Trauma	Mistreatment	Etrafındaki davranışlara göst...
Q9. Daha öncesinde hiç köpeğiniz oldu mu? ...	ailimle yaşıyodum. Barne...	Background	Background story of the...	Sahibinin hastalanması sonu...
Q9. Daha öncesinde hiç köpeğiniz oldu mu? ...	ailimle yaşıyodum. Barne...	Trauma	Mistreatment	Bannakta diğer köpekler tar...
Q9. Daha öncesinde hiç köpeğiniz oldu mu? ...	ailimle yaşıyodum. Barne...	Adoption	Reasons for adoption	Küçük ırk olduğu için banna...
Q9. Daha öncesinde hiç köpeğiniz oldu mu? ...	ailimle yaşıyodum. Barne...	Trauma	Mistreatment	Sahiplenenler balkonda baki...

Figure 11 - Screenshot of Data Coding

As a result of this analysis, themes about the two main actors, the dog, and the human companion, emerged. Although the design solutions to be developed will be dog-centered and the primary user will be the dog, the role of the human companion should not be denied especially when the welfare of the dog and its life at home is considered. If we talk about an end-product, human is the one who purchases,

installs, and keeps it maintained. Even a product designed to be activated by the dog has to be somehow brought into the house, managed, and maintained during its product lifetime.

Since the welfare of the dogs is directly related to the relationship with their human companions, I have also included the experiences of humans during and after the adoption process with their dogs in the analysis. Therefore, I believe that bringing the experiences of humans as the secondary users to the research and design process does not mean that the focus shifts from the animal. Because priority is still given to the needs and wishes of the animal and their perspective plays the leading role throughout the processes. Since I have not directly consulted dogs in my study, I have strengthened my method for this limitation by conducting interviews with the experts who are directly studying with dogs and referenced ACI literature cases who are targeting dog participants directly.

Since the act of adoption plays a triggering role in the formation of the themes, I accepted adoption as the origin and showed the whole analysis setup by dividing it into two main time periods as before-adoption and after-adoption. The dashed line in the thematic map of dog interview analysis, given in Section **4.2.2** as Figure **15**, indicates the separation of time periods. I have discussed the results in detail in subsections of Section **4.2.2**.

CHAPTER 4

RESULTS

This chapter comprises two main sub-chapters, namely Literature Review Results and Interview Results. The main purpose of this chapter is to collect the results that will provide input to the design guidance aiming to satisfy the selected context of increasing the welfare at home for the target user group of adopted dogs.

Considering the holistic structure of the design, the technology interaction cases presented in the ACI Conferences with dogs are examined regardless of the selected context, and information regarding the characteristics of the interaction modalities of dogs deduced from the literature of Animal Studies are presented in a concise form. These findings are summarized in the Literature Results section. Details of the reviewed cases are given in Appendix A.

The results deduced after the analysis of the interviews, which were designed and conducted to make input for the selected specific context, are given in the Interview Results section. Interviews with dog behavior experts and dog families are analyzed and presented in groups that would form the guidance.

4.1 Literature Results

As discussed in Section 2.1, animals' relationship with technology goes way before the emergence of ACI field. However, in this close relationship, animals are not always the active users of the technology in concern. Even for the cases where they are claimed to be the end-user, benefits obtained as the output of the study may not align with their needs and contribute to their welfare (Byrne et al., 2018). At this juncture, studies executed in the field of ACI steps in. With its manifestation and goals, ACI field aims to count the animals as valid end-users of the technology in

question by putting their welfare at first and developing design and research processes with animals for animals (Westerlaken & Gualeni, 2016). It claims that only by taking their different modalities into account, their perspectives can be incorporated into these processes. Studies conducted in this field with different types of technologies and different animal user groups aim to explore how these divergences show their effect on the phases of a design process, such as how to elicit requirements that are in the benefit of the animal, which methods to be chosen during ideation and iterative design development, how to assess what is obtained to verify the determined requirements and so on.

This section presents the results obtained from the review of ACI case studies. Results show valuable deductions regarding the research process and design process that are transformed into guidance for designers in Chapter 5.

4.1.1 Focused Dog Types

The literature I have reviewed has two main branches. One is the ACI field where I have extensively focused on the cases conducted with dogs and the other is animal studies field, specifically welfare of dogs.

In the case studies I have examined, dog participants chosen by the researchers can be grouped into two as working dogs and domestic dogs. Since they are in the same species, they do not differ when it comes to the interaction modalities they use. Main difference to be noted between working dogs and domestic dogs is that working dogs are specifically trained for achieving the task required by their chosen occupation. This directly affects their familiarity with training, hence the type of their participation. They are preferred for their ability of learning new commands (Alcainho, Valentin, Abowd, & Jackson, 2016), (Byrne et al., 2018).

Welfare studies conducted to explore all the related parameters for dogs are mostly performed in controlled settings such as shelters, veterinaries, and laboratories. While they give rich insight about the welfare of working dogs, dogs kept in captivity

in shelters, or clinical dogs, a consensus on the features for the welfare of dogs living in domestic settings have fewer studies in comparison. One affecting factor is that the living conditions of domestic dogs vary significantly (Stafford, 2007).

The main motivation for working dogs is to reach the reward. Their desire to obtain it makes them find some shortcuts affecting the accuracy of their performances. In addition to that, since they are living individuals and not mechanized detectors, their physical and mental states have a direct impact on their performance. Boredom caused by the lack of novelty, issues related to the harmony with their handlers, and fatigue due to their age is only some of the examples that might negatively contribute to the quality of their performance and eagerness of their participation (Zeagler, Gilliland, Freil, Starner, & Jackson, 2014). The same thought process and possible issues can be reflected in the design research studies conducted with dogs.

4.1.2 Modality Selection

In the ACI cases I have reviewed, researchers do not isolate one single modality and choose it as the driving factor for their designs. I have observed that in the interaction examples, different modalities are combined and triggered by visual, auditory and olfactory stimuli (Westerlaken & Gualeni, 2016).

Especially in design solutions that use the play element, dogs that are triggered by the movements or smells of the objects run after the objects, try to displace them with their paws, and try to grasp them with their mouths. These are mostly the affordances that appeal to the dog's natural behaviors (Westerlaken & Gualeni, 2016).

Solutions where abstract goals come into play, such as television screens and touch screens, require learning in dogs. In the absence of clear feedback, dogs can easily experience frustration, and their tempers can be activated according to their personalities (Ilyena Hirskyj-Douglas, Luo, & Read, 2014), (I. Hirskyj-Douglas,

Read, & Cassidy, 2017), (Ilyena Hirskyj-Douglas & Read, 2018), (Baskin & Zamansky, 2015).

Design solutions in which dogs hear the voices of their human companions can cause confusion and frustration in dogs, due to the lack of the element of smell, which is the main element in the communication of dogs (Resner, 2001).

Details of the modalities used, and design requirements obtained from the ACI cases specific to the modality in concern are presented in their respective sections.

4.1.2.1 Mouth

In the literature, there are examples of sensor equipped harnesses where an extension integrated to the harness allows working dogs to interact with in the form of biting or tugging to send a message to their handlers (Jackson et al., 2015). In such examples, where mouth is the designated interaction modality, size of the design is determined to allow grabbing affordance. Choosing the affordances appealing to the dogs' natural behaviors helps the researchers to easily train the working dogs to perform the interaction process.

Play as a motivating phenomenon drives some of the cases studied in the ACI field. There are smart toys offering One example is developed by researchers is remote ball fetching game (Mankoff, Dey, Mankoff, & Mankoff, 2005). In the design solution system, dog living at home can watch the human companion through the screen installed in their living rooms when human is at work. To satisfy the pack awareness of dogs, researchers do not only appeal to the visual cognition of the dog but also hearing abilities. Dog is able to hear the surrounding of human in their workplace through speakers. When dogs get bored, they present their natural behavior of lying down. Sensors under the area where the dog lies down sends notification to the human. In return, the human releases the ball from the system located near the dog and ball fetching game starts. Activation of the system starts

with the passive interaction of dog with its whole body. In the play session, the dog uses its mouth and paws to catch the balls.

Even though most of the examples choosing play as the motivating factor in the ACI case studies are targeted for dogs living in domestic settings, a study conducted by Byrne et al. (2018) uses play for quantifying temperament of dogs to assess puppy suitability for service dog training. In this study a silicone ball sensor and a silicone tug sensor are used, and dogs try to fetch them. Upon catching the objects, they use their mouths to bite and tug. In the Byrne and his colleagues' study, material of rubber/silicone rubber is used for toy appearance. Except for its appearance, such a material allows biting and chewing. It can be covered with a soft cover such as faux fur, to give it a toy or prey feel.

In a study developed by Westerlaken & Gualeni (2016), researchers create artefacts that are inviting playfulness and develop the artefact base on the playful preferences of dog participants. The first artefact, Sphero, is a Bluetooth-controllable ball where dog treat is added as puzzle inside LEGO bricks on top of the ball. Dogs run after the ball, sends it to different directions, smells the ball with the snouts but mainly, tries to take out the treats out of the ball by using their mouths. The second artefact, an open-ended toy with multiple compartments, has a sound emitting controller inside and objects having specific smells in the compartments. Dogs explore the artefact by sniffing, moving it around and trying to bite it. Hard plastic can be used in cases where a defined shape covering the memory cards or electronic routings is required. However, hard plastics are not appropriate for biting or grabbing. If it is meant to be used for such interactions, like in the case of Westerlaken and Gualeni's exemplified study, covering the hard plastic with a soft cover would help to overcome this issue.

Results of the reviewed ACI case studies show that food is used as the number one motivational source for dogs. Especially during training, treats are selected as reward markers along with play (Mancini & Lehtonen, 2018), (Westerlaken & Gualeni, 2016), (Jackson et al., 2015).

4.1.2.2 Snout

It is important for working dogs to activate some systems by touching the control surfaces like humans do. Used modality by dogs are driven by the sizing and installation location of the developed design solutions. In the examples of door opening buttons for mobility dogs, an installation location at the snout height of the dog allows them to nudge the surface with its snout (Mancini et al., 2016), (Ruge et al., 2018), (Ruge & Mancini, 2019). Same goes for other operating switches and light buttons as well. Not only the installation location but also smaller sizes chosen for the control surfaces lead dogs to use their snouts (Mancini & Lehtonen, 2018). Even though snouts are naturally used for olfactory activities, in these examples, they are engaged in touching action.

For detection dogs working in the cancer studies, smell of the samples is the main distinguishing character. Experiment setups in the literature is formed of pressure sensor supported metal assemblies carrying the cell samples on the surface (Mancini et al., 2015). Dogs mainly sniff and at times lick the sample while interacting. The frequency they pay attention to a sample in question and the time spent while sniffing give comparable information to the researchers. Researchers make use of the natural duties of snouts in this example, which is the olfactory activities. Surfaces parallel to dogs' noses are preferred in the study.

Another example of snout usage for interaction targets the assistance dogs as main users (Zeagler et al., 2014), (Byrne, Zeagler, et al., 2018). They are presented a touchscreen. Main aim for dogs is to track the targets on the screen in a row to activate a process for help. Virtual targets in circular shape with different colors are introduced to the dogs and they are trained to follow a touching pattern to convey messages in emergencies. Even though snouts are used in these examples for touching, their natural usage show its effect in these examples. A salient outcome is that remaining of the saliva on the screen from previous trials create occasional distractions for dogs. Because the dog stops sniffing the left-over treat scent in the

saliva, this creates a deviation in the output due to the thinking interval instead of choosing the new target.

In touchscreen usage, the screen needs to be located at the height of the dog's head level. For different-sized dogs, vertically adjustable systems offer calibration specific to individuals (Byrne, Zeagler, Freil, Rapoport, & Jackson, 2018).

Although olfaction could be defined as the strongest sense of dogs, as explained in Section 2.1.5.1, according to the results of the ACI case study review, sense does not seem to have made much input to the case studies with its natural usage. There are not many studies in which the odor is actively used. That might be the result of dominating effect of the anthropocentric approach in the study design. In one of the rare examples of using the smell as an active stimulus, researchers aim to trigger the olfactory memories of dogs by hiding pieces containing scents that might be familiar to dogs into the compartments of the prototype toy for them to explore (Westerlaken & Gualeni, 2016). As exemplified in Section 4.1.2.1, to give the toy appearance, the researchers enclose their prototype by a soft cover. Saliva contamination on the cover during play sessions is eliminated by the feature of the soft cover being removed and washed. Washing before usage would help to eliminate the unintentionally misleading odors.

4.1.2.3 Paws

Paws are treated as the human counterparts of hands in most of the literature cases. One of the ACI literature's early studies conducted by Resner (2001) facilitates a touching object in a webcam-speaker setting to motivate the dog with treats. In the system, there exists a touching object in the form of a wired alley-oop to touch or a toy to squeeze with their paws. System allows the human companion to watch their dogs. They call their dogs and activates a clicker as they wish. Upon hearing the voice of the human and clicking coming along with it through the speakers, dogs display trick behavior by touching the object. To reward that action, human activates

the treat dispenser and interaction is completed. Researcher observes that treat dispenser acts as a more motivating triggering factor compared to the auditory input from the human.

Another treat dispenser integrated system developed by Geurtsen et al. (2015) imitates a digital hide and seek game with two buttons and two speakers. In this game, a pre-recorded voice clip of the human companion is used as the trigger. It is played through one of the speakers that is located behind the buttons. When the dog presses the correct button, to choose where the voice has come from, a treat is given through the treat dispenser. Two buttons-two speakers-a treat dispenser system to imitate a digital hide and seek game (Geurtsen, Lamers, & Schaaf, 2015). Pre-recorded human voice is used as a trigger. When the dog presses the correct button using its paws, treat is given.

As explained in the snout modality, installation of location for control surfaces of systems that are used for activation may cause dogs to choose their paws for interaction. For operating switches and light buttons installed in lower positions, dogs tend to use their paws for touching (Mancini et al., 2016). However, in these cases relation between the size of the dog and switch/button placement is critical. Because dogs in big sizes are observed having trouble for reaching the buttons placed on lower positions.

The feeling of activation coming from the movement of the switch acts as feedback, allowing it to be noticed (Mancini et al., 2016).

Using metal in designs containing dynamic mechanisms, such as moving mechanisms in a linear or rotational manner by force exertion, may cause slippage. For this, making a lightly rough texture finish, the haptic feeling under the paws is increased and slipping is prevented (Mancini et al., 2016).

For systems that are requiring force activation, dogs tend to stop trying if it gets harder to manipulate (Mancini et al., 2016). Applicable force should be designated depending on the size and physical capabilities of the target users.

Researchers Baskin & Zamansky (2015) choose play as the main motivation for dogs in their study. They develop a touchscreen interface containing a prey hunting game. In this system, main aimed modality is catching the virtual targets via paws. However, interaction of the dog starts with eye-tracking the target and head twisting, continues with not only paw usage by scratching and pushing the tablet but also licking the surface as a natural behavior. When the dog successfully catches the target, auditory feedback is given by the system. During the play session, researchers observe that dogs jump around the tablet and by getting confused of the target being virtual, the dog participants try to look under the table in search of a physical target.

4.1.2.4 Haptic Feedback

Some cases in the ACI literature offer passive interactions to the dog participants. In these cases, wearable technologies such as collars with location tracking and health tracking are used (Mancini et al., 2012), (Nelson & Shih, 2017). Even though main interaction is passive in the form of wearing, dogs visually interact with the collar. Upon seeing it, they associate it with certain activities, such as going out or play session outside of house. Hearing the clicking sound of the collar when strapped helps association building as well. Target users of these technologies are mainly dogs living in domestic settings with their human companions.

Another form of wearable technologies harnesses with sensors are used for the studies with working dogs. In one of the studies, to satisfy communication from handler to the dog, safe vibrations conveyed through the harness is used to deliver messages (Byrne, Freil, Starner, & Jackson, 2017). Intensity of vibrations are really important in such uses, because it might trigger possible past traumas of the dogs. Another important parameter is the coat type of the dog user. While locating the devices giving tactile feeling, such as vibration motors in this study, coat density and its isolating nature should be considered.

In order to fit dogs in different sizes, adjustability should be introduced to the design of wearable technologies (Jackson et al., 2015).

For wearable design solutions, obtained weight should stay in a range such that it does not cause any physical discomfort or damage to the dog. Even though earlier studies suggest the device to weigh 4-5% of an animal's weight, according to the experiments of Valentin, Alcaidinho, & Jackson (2015), 2% of the body weight is sufficient for the developed artifact.

The weight of the artifact should not be such that it impedes movement or compels a modification of the natural movement (Valentin, Alcaidinho, Howard, Jackson, & Starner, 2015, 2016).

4.1.2.5 Body motion

Not only body parts of dogs but also head gestures and full body in motion are used in the ACI field as modalities. An example where full body in motion is used is a study conducted by researchers is a remote ball fetching game where play is the main motivator for dogs (Mankoff et al., 2005). In the design solution system, dog living at home is able to watch the human companion through the screen installed in their living rooms when human is at work. To satisfy the pack awareness of dogs, researchers do not only appeal to the visual cognition of the dog but also hearing abilities. Dog is able to hear the surrounding of human in their workplace through speakers. When dogs get bored, they present their natural behavior of lying down. Sensors under the area where the dog lies down sends notification to the human. In return, the human releases the ball from the system located near the dog and ball fetching game starts. Activation of the system starts with the passive interaction of dog with its whole body. In the play session, the dog uses its mouth and paws to catch the balls as well.

Head gestures are preferred mainly for wearable design solutions in the ACI literature. Target users of such design solutions are mainly working dogs. Main aim

is to send messages to the handlers of the working dogs. Jackson et al. (2015) chooses sensor equipped harnesses for their study, while in a similar study, collars with sensors are used for the same purpose (Valentin et al., 2015).

4.1.2.6 Vision

For the visual modality, television screens are used in the ACI literature. A series of related studies are conducted to discover the different directions of dogs' visual interests.

The first study conducted by researchers explored the possibility of dogs having meaningful interactions with TV screens (Ilyena Hirskyj-Douglas et al., 2014). They make use of face tracking to obtain quantitative data.

The following study continues with offering different screens and media content to understand whether dog participants choose to watch TV in front of them and if they do, what their preferences are (I. Hirskyj-Douglas et al., 2017). Since dogs have different hearing capabilities, volume of the videos is chosen not to be too loud for dogs and blank screens are shown in between the videos in order not to overwhelm the participants.

In continuum of this study, researchers created another setting with an automated screen device controlled by body tracking, to explore the interaction modalities between television and dog, giving control to a dog to activate the screen (Ilyena Hirskyj-Douglas & Read, 2018). The system used in the study comprised of a monitor, a webcam, two speakers, and an Arduino tracking/sensing device showing selected media clips and accompanying sounds. To give control to the dog, system has two modes. Mode one, tracking the dog's behavior but not responding with activation and showing media clips and mode two, activation and playing media when the dog enters the tracking area. This does not only help the dog to adopt to the system, but also created a baseline for a fair comparison to assess the dog's

interaction with the system correctly. For such studies conducted with dogs, creating a baseline is critical for comparison.

Vision is the most design-related result giving sense in the results of the ACI case study review. This could be related to the opposite of the reasoning given in the Section 2.2.1 regarding the anthropocentric approach to the study design. Visual cues are highly integrated into the design studies for humans, hence, even though it is not the strongest sense for dogs as explained in Section 2.1.5, human designers seem to focus on vision more compared to other senses. Following examples of design requirements are all obtained from the ACI case study review where the vision is primary input for the modality.

Size:

For a physically activated object to be a target, it must be big enough to be noticed by the dog (Mancini et al., 2016).

Smart toy type of technologies either moving or inanimate should not be too big for a dog to feel threatened otherwise they can show their hesitation by barking (Westerlaken & Gualeni, 2016).

If an SD card for recording or a sensor for measurements is to be placed inside of an object, dimensions of these components can be the parameters determining the smallest size (Byrne et al., 2018).

Shape:

Rectangular-shaped objects named bringsel are used for the training of working dogs. To form a relation and trigger behaviors such as biting and tugging, rectangular shapes can be used (Jackson et al., 2015).

Usage of oval shape increases interaction and activation area (Jackson et al., 2015).

If a virtual target is to be created, its form can have regular shapes such as circles, or familiar shapes such as ball and rat to resemble a toy (Baskin & Zamansky, 2015).

In the study findings, it is indicated that abstract cues are challenging for dogs to comprehend, and they prefer interacting with tangible cues.

Color:

Dogs are believed to be dichromatic, ranging between blue and yellow. Wavelengths in between these appear to be blends white (Ruge & Mancini, 2019), (Mancini & Lehtonen, 2018).

The background color is important for perceivability. When yellow or blue is used as the leading color, usage of hues closer to them on the background makes it difficult to differentiate (Zeagler, Gilliland, Freil, Starner, & Jackson, 2014), (Mancini et al., 2016).

The transparent background might create confusion because it offers no contrast (Mancini et al., 2016).

Material:

If the outer material in products like a moving robot does not appeal to the dog, covering it with a soft cover and adding feather extensions can increase the interaction (Westerlaken & Gualeni, 2016).

4.1.2.7 Audition

While being used as a stimulus, the voice of the human companion or the voice of other animals can be preferred (Resner, 2001).

A human companion's voice may sound different when coming from the speaker. By practicing familiarity with the sound, dogs can be accustomed to it (Resner, 2001).

Sound can be used as feedback, such as the clicking sound that comes while a collar is snapped or when a mechanism is activated (Mancini et al., 2016). For such sound, it is enough for them to be just audible because of the threshold of hearing of dogs. Louder sounds can be disturbing and directly affect welfare (Ruge, Mancini 2019).

For touchscreen interfaces, a tone with changing frequencies is played depending on the target selected for feedback (Zeagler et al., 2014).

4.1.3 Understanding the Dogs

Due to the communication barriers between the researcher and the participant, one of the toughest challenges in design research with animals is to understand their needs and interpret their behaviors. For the studies conducted in the ACI field, different methods are used to elicit requirements for the design and to make sense of the behavior during the user testing of the developed design solutions. In this section, results obtained from the review of ACI case studies for understanding the dog user are presented.

4.1.3.1 Interviews with Human Companions

Since differences in communication channels with another species present themselves in design projects conducted with dogs, researchers make use of dogs' human companions as intermediaries through conducting questionnaires and interviews (Mancini et al., 2012), (Jackson et al., 2015), (Ilyena Hirskyj-Douglas & Read, 2018). In the questionnaires and interviews, both Likert scale questions and open-ended questions are used. Likert scale is a point scale allowing people to indicate how strongly they agree or disagree with a given statement. These types of questions are preferred to quantify the interaction of dogs with the technology and their observed emotions (Nelson & Shih, 2017), (Baskin, Zamansky, & Kononova, 2016), (Ruge et al., 2018). Open-ended type of questions provide detailed insights regarding the experience (Ilyena Hirskyj-Douglas & Read, 2018). These conversational techniques are used during the different stages of the studies.

At the beginning of the study, researchers prefer conducting questionnaires and interviews with the human companions of dogs to elicit the requirements (Valentin, 2019). Such introductory interviews help to understand the background of the dog

users (Jackson et al., 2015) and experience of the dog with technology used in the domestic setting (Mancini et al., 2012).

During the study, field interviews are preferred for following the processes with the observations of the human companions. It is mostly preferred for the technology that is used in a domestic setting for a period of time or for wearable technologies like collars, which are used for tracking, either used at home or during the daily walks out of the home that dogs and their human companions go together (Mancini et al., 2012).

At the end of the study, concluding interviews are performed to assess the process. Since human companion knows the typical behavior of the dog during their daily life, it gives a chance to compare the changing behavior of the dog during the usage of the technology in the study (Ilyena Hirskyj-Douglas & Read, 2018).

However, it also naturally introduces human bias, as well. Even though human spends a lot of time with the dog and is familiar with their reaction towards different stimuli, they are not experts on animal behavior and their assessments still become on behalf of the dog and are not direct, and hence might fall short.

4.1.3.2 Ethnographic Research

Multispecies ethnography is a method of qualitative participant observation method, where human researcher interact with nonhuman actors (Kirksey & Helmreich, 2010).

Observation is one of the highly used ethnographic technique (Zamansky, Linden, & Baskin, 2017). During the observations, researchers take notes and images, record videos to support and enrich their data (Westerlaken & Gualeni, 2016). The recordings help the researchers to review the details of the experience in a more detailed pace (I. Hirskyj-Douglas et al., 2017). This method can be used in different stages of the study.

For the initial stages, it helps to understand the underlying issues defining the design problem (Mancini et al., 2012). It helps to understand the selected user group in a given context of use. To be able to reach accurately representative results, researchers observe the users and interact with them in their environment (Mancini et al., 2016).

During the user test stage, it is used to directly observe the interaction of the dog with the developed design solution (Westerlaken & Gualeni, 2016). Analysis of the insights are used for the iterative development of the design solutions.

4.1.3.3 Expert Observation

To eliminate the lack of expertise, some studies include animal experts in the observations (Mancini & Lehtonen, 2018). Video recordings of the home or laboratory-based studies or direct observation for the studies conducted in a laboratory setting are used in such evaluations. Animal experts help to clear the subjectivity introduced by the human companion with their expertise. To strengthen the objectivity in the assessment, experts and researchers consult additional inputs as scientific data. This helps to avoid human bias, whether human companion or expert, as well.

4.1.3.4 Collecting Body Data

To support and strengthen the obtained qualitative data additional quantitative data can be used. To answer this need, in some of the ACI case studies an invasive method of collecting body data is preferred.

There are different physiological indicators collected from the bodies of dog participants. Cortisol levels are one of these indicators and used to determine the stress state of dogs (Geurtsen, Lamers, & Schaaf, 2015). Type of the invasive method to be used should be selected carefully for preserving the welfare of the animal. For

instance, in the mentioned study researchers evaluate alternative methods of cortisol measurement namely excretion, blood, hair, or saliva. Based on their expert supported evaluation, **taking a blood sample** might directly impact the emotional state of the dog, **excretion** creates practicality issues for the scheduled time of the study, **collecting hair and saliva** is the least invasive way that could be performed within the natural limits of dog-human interaction. Selection between them is directed by the process of their analysis. While saliva is detectable within a few hours, detectability of cortisol level in hair takes longer periods. However, such quantitative data can be misleading by itself. In the specific example of cortisol levels, high cortisol levels could be a sign of both positive arousal (being excited) or negative arousal (being anxious). To clarify the obtained results, researchers apply to means of understanding the body language of the dog to give it a context to relate with (Geurtsen et al., 2015).

4.1.3.5 Collecting Device Data

Body measurements collected invasively are not the only way to collect quantitative data. Another highly preferred method is to collect data directly from the technological devices used in the study. Type of the collected data changes with the component used in the design solution. Table 5 below represents a summary of the device collected data from the ACI case study review.

Table 5 - Collected Data Types

Type of Technology	Collected Data
Collar	Tracking position, speed, direction (Mancini et al., 2012) Steps to measure exercise level and burnt calories (Nelson & Shih, 2017)
Harness	Sensor activation values and active time intervals (Jackson et al., 2015) Sensor response rate Number of successful/unsuccessful attempts for activation (Jackson et al., 2015)

	Gyroscope measurements (head angle, distance, angular velocity, acceleration) for gestures (Valentin, Alcaidinho, Howard, Jackson, & Starner, 2015) Acceleration of vibration motors for determined frequencies (Valentin, Alcaidinho, Howard, Jackson, & Starner, 2016)
Physically activated objects	Pressure data for activation (Mancini et al., 2015) Activation time (Mancini et al., 2016) Number of successful/unsuccessful attempts for activation (Mancini et al., 2016)
Touchscreen	Duration of touch (Byrne, Zeagler, et al., 2018) Number of successful/unsuccessful attempts for task completion (Byrne, Zeagler, et al., 2018) Location of the successful touches (Zeagler et al., 2014) Paths of the applied touch (Zeagler et al., 2014)
Screen	The location where the dog looks on the screen (I. Hirskyj-Douglas et al., 2017) Duration of visual interaction (I. Hirskyj-Douglas et al., 2017) Number of activations (I. Hirskyj-Douglas et al., 2017)
Smart Toys	Location and depth data by image processing (Pons, Jaen, & Catala, 2017) Number of activations (Byrne, Zuerndorfer, et al., 2018) Activation strength (in pressure or stretch resistance) (Byrne, Zuerndorfer, et al., 2018) Activation duration (Byrne, Zuerndorfer, et al., 2018)

4.1.3.6 Ethograms

Ethograms are important tools for any study conducted with animals including observation as a technique. Ethograms provide objective inputs for standardized depictions of the body language of the dog. It could be used for the data collected in an ethnographic study (Mancini & Lehtonen, 2018) or giving a context to the collected body data (Geurtsen et al., 2015).

In ethology, the science of animal behavior, ethogram is defined as a list of the type of behaviors for a specific species (Martin & Bateson, 2007). To eliminate any subjective interpretation regarding the behavior of the animal and be able to define

the observed behavior in common terms, a repertoire of natural behaviors with detailed descriptions is given in an ethogram (Hall & Roshier, 2016). There are many examples of species-specific and taxon-specific partial ethograms that are developed for the purpose of the research can be reached in the literature (Stanton, Sullivan, & Fazio, 2015). The scope and content of the ethogram depend on the purpose of the study.

One of the ethogram examples used in the ACI case studies is specifically developed for tail wagging of dogs, given in Figure 12. In the study, video recordings are used to quantify the tail wagging. In order to depict and distinguish the type of tail wagging, a developed ethogram is used (Ruge, Cox, Mancini, & Luck, 2018).

Participant: Odin

Tail Position	Tail Direction	Tail Angle	Tail Tip Angle
High	Left	90°	Tip 90°
Horizontal	Center	45°	Tip 45°
Low	Right	<45°	Tip at <45°

Figure 12 - Tail Wagging Ethogram (Ruge, Cox, Mancini, & Luck, 2018)

Another ethogram example which is not included in the ACI case study review but in the literature of animal studies can be examined to understand the features of ethograms is developed to describe the bodily expressions of dogs (Salgırlı Demirbaş, 2008). This obedience ethogram defines the facial expressions, head position, ears position, tail position, and body posture in detail. The part related to the ears position is presented in Figure 13 below.

Ears position	
Neutral	The pinnae are held partly sideways and completely upwards; opening is completely visible from the side
Maximally backwards	The pinnae are flat on the head
Backwards	The pinnae are backwards for more than half, are upright of buckled, they are in one line with the stop of the nose and are not flat on the head
Laterally turned	The pinnae are turned sideways; opening is not visible from the side
High	The openings point forward while ears held in an aroused position
Directed to the stimuli/owner	Each pinnae are directed to source of the stimuli by establishing different combinations of ear positions
Forward	The pinnae are directed forward to form an acute angle with the head

Figure 13 - Ethogram by Salgırlı Demirbaş (2008)

One additional ethogram example from the animal studies literature explores the differences in the dog reactions towards olfactory stimuli of human sweat in their different emotional states (D’Aniello et al., 2021). Ethogram given in Figure 14 interprets the behavioral patterns of dogs.

Behaviors	Description
Approach	The dog approaches the target. This behaviour was recorded when the dog was moving toward the door, the apparatus and the people (irrespectively whether it was gazing toward the face of other part of the body)
Interaction	The dog engages in physical contact with the target. It includes explorative behaviors, such as sniffing (from not more than 20 cm about). Furthermore, physical interaction with muzzle or legs, licking, jumping up the target were also included
Gazing	The dog looks at the target from a stationary position. Gazing behavior toward the people was recorded when clearly directed to the face of the subjects
Stress	All behaviors indicating a stressful response. Includes mouth licking (the dog licks its lips or nose), locomotion (dog walking, pacing or running around without a clear target or exploratory intent), shaking off, scratching, yawning, barking, yapping, panting, drinking water

Figure 14 - Ethogram in a Smell Study (D’Aniello et al., 2021)

4.2 Interview Results

In this section, I will share the data I obtained as a result of my interviews with dog behavior experts and dog families. Prior to these interviews, participants are not asked to get prepared for the questions. To help with their thinking process and trigger their answers, I have used some visual aids together with the semi-structured

questions, as explained in detail in Section 3.2. While explaining the results obtained from the interviews, I have followed a reporting manner. For the family interviews, I have also made use of the themes I have deduced as a result of the thematic analysis.

4.2.1 Expert Interviews

After the analysis of the interviews I have conducted with the animal behavior experts specializing in dogs, I identified potential welfare problems that dogs' might experience due to the differences they have after their adoption compared to their pre-adoption lives. Experts shared their opinions about the technology-based interactions when it comes to the design solutions developed for dogs. I have grouped the factors related to the physiological characteristics of dogs that would direct the design solutions according to the sense of dogs. I have questioned the methods the experts use in order to communicate with dogs. Overall findings obtained from the expert interviews reveal important features of the adopted dogs and their behavior at home after adoption.

4.2.1.1 Background of the Dog

Participating experts stated that adopted dogs are divided into three groups based on their personal history:

1. Stray dogs living on the streets
2. Dogs who are kept in shelters
3. Re-homed dogs

Experts state that the background story of dogs before their adoption is important in order to understand the changes in their living conditions, the incidents they are exposed to, and the behavior patterns created by bad experiences that can be called traumas. This information is necessary input for designers to create specific user

profiles. Correctly identified user profiles help designers reach user-centered design solutions.

According to both experts, although the motivations and adaptations of dogs that came from streets, shelters, or other homes are different, they are common in terms of the behavior they display. They further explain the displayed behaviors as some may express the destructive behavior because of anxiety, while the others may act it out due to panic.

Detection and solution of the problems underlying the behaviors are the tasks of the experts. However, it is the designer's design solutions that might help mitigate or change these behaviors.

Experts see the most fundamental problem faced by **dogs coming from the streets** as survival, which depends on finding food and shelter. They state that the most important factor that disrupts their mental stability is exposure to varying human attitudes. Expert B states that people who feed dogs at random points on the street for consecutive days create expectations in dogs. Because of this expectation, they approach to anyone carrying a bag in their hand, hoping for some food yet receiving shouting and physical damage instead. Expert A states that these trauma-related problems manifest themselves as shy attitudes in dogs, hesitation in approaching people, and difficulty in trusting people. Both experts describe the dogs with such background exhibiting a habitually explorative behavior at home after being adopted. Because even though they were living in a possibly dangerous environment, they were free to explore their surroundings.

The experts depict the shelters as crowded environments where dogs constantly struggle for food or bed. Expert B defines the stress that **dogs with shelter background** are exposed to as “hierarchical” based on these struggles between dogs.

Dogs that are left to the streets, shelters, or veterinarians after being cared for at home for a certain period of time are called **re-homed dogs** after their re-adoption. At the

root of the problems observed in these dogs is the fear of abandonment, as stated by the experts.

Experts state that the age at which dogs are adopted can have an impact on the reactions they will exhibit in their home life and the problems they may experience regardless of their pre-adoption history. Expert A describes the effect of age as follows:

“Infancy is more of an oral period, hence, to satisfy their curiosity they perform oral exploration. In the juvenile period, especially male dogs’ activity reaches the highest level. This period includes fears, as well. Prior to this period, expression of fear is usually in the form of running away. With the effect of excess testosterone, they start expressing these openly and vocalization is observed. This period is followed by calming down, where their personalities are set. Although the timing varies according to the races, it is accepted as an average of 18 months. After the age of 8, the senile period begins, similar to the senior ages of humans. Cognitive decline begins with old age.”

4.2.1.2 Welfare Issues

Both experts state that the three most common problems with adopted dogs are separation anxiety, vocalization and object traumatization. Expert B interpret the dogs’ inability to tolerate as the biggest factor in dog relinquishment. While explaining these problems and the other problems that accompany them, experts provide us information helping us to move away from anthropocentric thinking by revealing the dog point of view.

Expert B emphasize that even though dog welfare is often thought of as physical conditions, mental conditions of dogs are more effective. He expresses that separation from the human companion and loneliness is the most distressing factor for them and solutions should be developed for them to tolerate it.

Following sections explain the main welfare issues observed in the adopted dogs by the experts in a reporting manner. Since separation anxiety is an issue more general and feeding other issues as well, it is not evaluated by itself. In addition to the main issues of vocalization and object traumatization, other effective issues observed by the experts are explained relating them to the background of the dogs.

4.2.1.2.1 Vocalization

Expert A states that vocalization is one of the most observed issues at home after adoption especially for the dogs with street background. The reason for that is the habits they carry over from the streets. While on the street, they used to react to any sound they perceive without repressing themselves, and naturally, they continue doing that at home.

4.2.1.2.2 Object Traumatization

Another highly observed issue at home setting is object traumatization, i.e., damaging the objects such as furniture or even the structure of the house like doors and walls. Both experts define the main motivation under this behavior as curiosity to explore. It is common for dogs with all pre-adoption backgrounds. Another reason of object traumatization, especially valid in the case of dogs with street background as stated by Expert A, is their unfamiliarity of any domestic concept, such as furniture, because they were never introduced to it. They cannot make sense why they cannot gnaw a piece of furniture like they did to a tree on the street.

4.2.1.2.3 House Soiling

Expert A expresses that inappropriate elimination behaviors are not expected for dogs coming from the streets because they were using outdoor locations for urinating and defecating. Expert B defines toilet habit as a physiological phenomenon.

According to him, it is formed with training and guidance, and requires more effort in puppies compared to adult dogs. Both experts agree that with simple training, the concept of outdoor elimination could be consolidated.

4.2.1.2.4 Inactivity

Expert A explains the reason of not changing the location at home for the dogs with street background as the shyness-related behavior model they have developed because of the traumas they have previously experienced. Trouble of approaching humans and trust building issues manifest themselves in such mood. For this reason, their human companions put their food and water close by in order to prevent malnutrition.

4.2.1.2.5 Noise Aversion

According to Expert A, 80% of dogs with street background have sensitivity to sound. This sensitivity is so critical that, their thunder and rain phobia may give them panic attacks. The expert states that contrary to popular belief, hearing these sounds on the street does not make these dogs desensitized, on the contrary, they become more sensitive.

4.2.1.2.6 Personality Suppression

To protect themselves in the shelter environment, dogs with shelter background build a character where they suppress their behavior and act indifferently unless they have to do otherwise. Until recovery from this state, approximately 6 months after their adoption, as stated by Expert A, they continue hiding their personalities and reaction-related behaviors. As they adapt to their new environment, they unleash their genuine reactions and show them suddenly with an amplified magnitude.

4.2.1.2.7 Food Bowl Aggression

Food bowl aggression is a stereotypical behavior expressed by dogs with shelter background, as both experts agree on. Crowded and competitive environment of the shelter cause the dogs to have trouble to reach the food. As Expert B described, they exhibit a territorial reaction to protect their food.

4.2.1.2.8 Obsessive-Compulsive Disorder Behaviors

Expert A attributes the obsessive-compulsive disorders displayed by the dogs with shelter background, such as scratching, eating their tail, constantly turning around themselves, or continually licking themselves, to their chronic cage stress.

4.2.1.2.9 Excessive Attachment

Expert A states that the excessive attachment to the human companion is not something generally observed with dogs with street background. However, it is frequently witnessed for the re-homed dogs. As the expert depicted, they act like an abandoned child. They try to always keep their human under surveillance, like taking a position where they can see them even if they go to the toilet and shower. To ease the fear of relinquishment and needy behavior accompanying it, Expert A suggests giving the dog the following message by the human's actions:

“This is your home; you are safe here and you are an individual that can be happy on your own.”

4.2.1.3 Design Requirements Based on Dog Features

In my interviews with the experts, I tried to obtain design requirements that would provide input for the designs to be made for dog users with the questions I asked them. As I explained in Section 3.2, I supplemented my main interview questions

with some visual aids. The first of these, Perceptual Map aims to explore positive and negative stimuli existing in a domestic setting that might affect dogs. These stimuli related answers reveal illuminating facts about the interaction modalities and respective design requirements for these modalities from the point of the animal behavior experts.

4.2.1.3.1 Interaction Modalities

In the literature, design studies for the interaction of dogs are predominantly in the field of ACI. Therefore, when I asked the experts about the interaction of dogs with technology, Expert B evaluated the topic directly with dogs' relationship with tablets. He emphasizes that dogs are primitive creatures and not having any complex thoughts. Hence, he finds the effort of entertaining a dog with a tablet 'utopic' and defines the fundamental reason of it as the anthropomorphic practices of humans.

Expert A states the difference between humans and dogs while interacting with technology is that, while humans do it willingly and consciously, dogs are taught these interactions and compelled to perform those by humans. The expert states that most of the technology examples for dogs actually serve for the benefit of humans. She exemplifies that with automated treat dispensers. It is a convenience for the human but when thought from the perspective of the dog, the device might reinforce the anxiety of dogs because while human companion is not there and unreachable by the dog, a treat is provided without knowing the emotional motivation of the dog. Another example the expert gives is the usage of computer as a communication tool for dogs to connect with their human companions. She states that frustration sensation would be inevitable because dogs have to touch and smell to make sense of it and vision would be of secondary importance.

Expert B prioritize the modalities of interaction for dogs as smelling and tasting and then touching. Expert A relates the type of the modality with the intended action.

Paws are used to discover the things to be laid on and other than that oral exploration with mouth is the predominant modality for dogs.

Expert A pays special attention to the dog snout. She defines the snout as not only a sensitive area but also the source of information flow in the dog anatomy. That is why dogs would not prefer this resource to be blocked by using it as an interaction modality to touch something for activation or selection. For such selections, the expert advises offering alternatives to the dogs and gives the case of cancer detection dogs as an example. It is enough for them to get a reward if they stand in front of the sample containing cancerous cells. No nose or paw touching is expected from them.

4.2.1.3.2 Smell and Taste

The action of smelling is defined as an activity that is relaxing the brains of dogs by Expert A. While they are outside, dogs go through the sequence of smelling, reaching the target, and self-discovery. The achievement of discovery provides success and satisfaction, hence it both works on dopamine receptors and relaxes the brain with the effect of meditation.

Expert A emphasizes on the olfactory sense of dogs in their communication. In addition to their body language, they send message by the odor they emit. While we are trying to imitate their moves, for example in a play session together, we only replicate what we see, missing the part what we cannot smell. The expert exemplifies in a physical game such as hugging and wrestling, while the dogs are waiting for a positive game message in the form of an odor, we fail to supply that, hence our play partners think of themselves and try to save themselves by making a move to our empty, bare faces.

Experts indicate that amount of the scent is important for dogs. Expert A states that even a small amount of scent can activate dogs' olfactory system. Intense scents can cause desensitization, hence not needed. Expert B highlights that dogs dislike heavy scents such as smell of cigarette, perfume, air-freshener and incense.

Taste should be considered in relation with smell because dogs make sense of taste through smell. Expert A explains that dogs have their own preferences and palate when it comes to food, like we humans do.

Expert B reveals the hormonal impact of mastication, the act of chewing. When they chew on food or any chewable toy object, serotonin, endorphin, dopamine and especially gaba are released. Act of mastication, as he states, increases the release of antistress hormones.

4.2.1.3.3 Vision

For the sense of vision, there are sharp distinctions between humans and dogs. Expert A likens them to color blind people. She states that dogs like to work with colors, but they cannot see the color of red or distinguish the in-between colors.

Light intensity is particularly important. Expert A explains that they see well in the dim light, and they need only little sunlight. Very bright light or flashing visuals can cause anxiety, especially for dogs coming from the street. Expert B emphasizes that decoration in the house should be done accordingly. Dim light or light coming from the floor to the ceiling would be a better stimulus for them. For the colors, the expert states that shining or glaring ones should be avoided and matt ones should be preferred.

Expert A interprets ball-like objects as an element of excitement in house dogs. She reminds that the dogs coming from the street have no knowledge of game. For them, textured things like a tree branch are visually appealing, because they like to gnaw at them.

Expert B explains that dogs follow body language of humans for communication. Fewer usage of the body language or misuseage could be misleading for dogs. He also adds that for the motion of the visual stimuli, objects in motion like robot vacuum-cleaners or objects changing shape so abruptly like opening an umbrella might create anxiety for dogs.

4.2.1.3.4 Hearing

Both experts state that voice can be a strong stimulus for dogs. However, it must be controlled very carefully.

Expert A explains that the voice of the human companion first creates excitement, but if the person is not physically present, the excitement then turns into frustration. Frustration, in return, triggers many behavioral disorders. If desensitization is to be done for dogs experiencing sound anxiety, it is important for dogs' emotional motivation during that time to be positive. Sounds played in the absence of the human companion conversely may sensitize the dogs more.

Another possible frustration regarding with the voice is defined by Expert B as the voice command of the human companion. He states that long sentences, too many voice commands and affectionate tone of voice teases the dog. To avoid any confusion and frustration, clear directives with one word should be given. Playing a tune could be used as an alternative. By teaching the dog the consecutive correlation between the tune and the desired action, dog can easily learn that tune equals to treat after a couple of repetition.

Music is not only used for such operant conditioning. Expert A reveals that dogs have musical tastes too. They respond better to their favorite music. To generalize, classical music or ambient music consisting of sounds close to nature or meditation music can be attractive to them.

Different to human perception, dogs can hear sounds that we cannot do. Expert B mentions the sonic sounds emitted by the technological devices at home. Even though dogs get desensitized by time, it still disturbs them. Hence turning them off while the dogs are alone at home might be a safe choice.

4.2.1.3.5 Touch

While talking about the sense of touch, it must be divided into two as active touch, where dogs touch the objects by their parts and passive touch, the body parts on which they are touched.

For the surface where they get into contact with their paws or whole body parts, Expert B states that dogs do not feel comfortable with shiny, slippery floors like tiles. They prefer surfaces like grass or carpet.

Expert A reveals that dogs have the perception of softness and hardness regarding the materials they get in contact with.

It is important that the material used in the products the dog interacts with does not break down when they are performing activities such as chewing and licking. Expert A states that although wood-like materials attract their attention due to nature-based resemblances, they can cause problems as they are easily decomposable. Expert B emphasizes that furniture selection in that sense can be critical.

If dogs are in need of itching, Expert A suggests that satisfying this need should be under their control. She exemplifies a system dedicated to this purpose should activate when the dog leans on it and be adjustable as the dog wishes.

In the interview parts where I have benefitted from visual aids, I have used the Body Map given below. As I have explained in Chapter 3, experts give information about the interaction areas of dogs by marking the relevant body parts on the Body Map. Detailed size of the map is given in Appendix B - **Interview Questions and Mindmap for Animal Experts**.

As a general deduction from the explanations of the experts, dogs do not like the touch of a stranger. They have to see the stimulus and be willing to interact with it. The preferred area of touch may vary depending on the dog, however, what does not change is their will.

Expert A draws the visible area for dogs as the area above their eye level, as if “wearing a hat”. Because of that when a person wants to meet or interact with the dog’s head, she advises that they should bring their hand to the dog’s eye level and let the dog see it before making a contact. Cheeks could be the area to start touching, but the nose area is a big no for dogs.

The middle-aged dogs like their back and rear area to be scratched in a familiar environment, under their control as explained by Expert A.

Both experts depict the areas around the mouth, ears, and back as available for interaction for only dogs’ human companions.

Another generalization stated by both experts for dogs is that they are not fond of touch on the tail area. Joints and paws are sensitive areas and can be bothering to be touched for most dogs.

As both experts highlight a couple of times during our interviews, dogs should not be caught in surprise for strangers. Contacting to areas such as the side of the head or neck area should be preferred for a dog to keep the human in sight.

4.2.1.4 Understanding the Dogs

There is a variety of ethograms depicting the behaviors of an animal in relation to their body posture, as discussed in Section 4.1.3.6. In the interviews conducted with the experts, I have made use of such two ethograms to create my visual aid the Behavioral Maps. This visual aid is explained in Section 3.2 and can be examined in detail in Appendix B - **Interview Questions and Mindmap for Animal Experts**. Based on these visuals, experts are asked how to read the signs of dogs’ posture.

Results of their responses indicate that signs dogs are expressing must be considered holistically in order to reach a realistic result. Experts assess the dog behavior in a combination of two groups:

- They look at the overall facial expression and body language, as explained more in detail below.
- They observe the behavioral strategies dogs exhibit in a stressful state. They expect to see escape, inhibition suppression (freezing), spraying or lightening the mood of the environment.

Overall interpretation of the body language and behavior gives a hint about the personality of the dog being pessimistic or optimistic.

While evaluating the body language of the dog, animal behavior experts control if the dog's overall posture is neutral and body parts like ears and tail hold their neutral position. If there is an observable change, then that indicates they are in a negative emotional state. However, the type of the emotional state and underlying possible reasons are not easy to formulate.

Both experts state that approaching to a dog with a stretched-out hand above their head level is perceived negatively by the dog. Holding the hand below vision line and waiting for the dog to bring its nose towards you gives a chance to the dog to observe and approach. Dog's approach indicated their request for a contact.

After getting dog's approval for the contact, experts emphasize that hugging should be avoided because it is not in the dog's body language. It feels trapped when hugged and according to Expert B goes into acute stress and choose one of the behaviors of fight, flight, or freeze.



Based on the body posture labeled as aggressive in the Body Map, Expert A states what is depicted is defensive aggression. There is also offensive aggression.

Dogs display defensive aggression towards human beings. It can be observed from the V-shaped mouth and flattened

ears.

Dogs exhibit offensive aggression towards cats and other dogs. In this case, the mouth is shaped like a C showing only the front of the teeth, and the ears point to the target.



Expert A expresses that body posture labeled as playful is misleading, because dogs might take this stance when yelled at as well. She relates this posture with stress and likens it to a child making cute moves in a stressful environment to try to save the situation.

Similar body language is observed for appeasement and playful behavior, while first being positive and the latter being negative. Appeasement may indicate an emotional conflict. The dog tries to turn the negative situation into a positive one to soothe and satisfy the other party they are interacting with.

Expert B gives details about the areas on the dog body that is open to play when the dog allows it. Due to lactation, female dogs have high erogeneity around the belly



area and might enjoy manipulation of this area. Dogs with passive surrender may enjoy stroking the belly by opening their genital area. Male dogs enjoy the manipulation of the chest area, as it is the area they rub against during mating. If dogs are not accustomed to the

joint areas to be grabbed and pulled from a very young age, it is not something they like.

Expert A warns about the permission of dog for belly touch. She states that the body language gives hints about the emotional state of the dog for us to distinguish between being submissive or playful. If there is a situation where the ears are flat



and tail is between the legs, then this could be interpreted as the stance of surrender. Dog tries to deliver the message of “Please do not touch me, I will not hurt you.” by showing its one the most vulnerable areas on its body. If

ears and tail are in their neutral position in this stance, then that could be interpreted as a relaxed state and open to be played.

Expert A compares the stance of submissive and relaxed in the Body Map and states that what is shown as submissive can actually be relaxed. Dog creates comfort area to itself. It can also show submissiveness depending on the situation, depending on the stimuli. What is shown as relaxed might be it when the emotional motivation is positive, or it could be the transition stance to the submissive when the emotional motivation of the dog is negative.



When it comes to the posture labeled as frightened, Expert A evaluates that it could mean more than frightened. The dog taking that position might be sick, having gas pains or any other uneasiness. Just by looking at the position, it cannot be defined clearly.



When it comes to the term dominance, Expert A strictly expresses that there is no dominance in dogs as opposed to the popular belief. She depicts the posture given with the label dominant as a posing posture. In situations where the dog is not sure about the other party it faces, it is more of an effort to try to appear confident and not to spoil the mood. The expert defines it as imposing behavior.

Both experts agree on that the interpretation of the tail behavior is difficult to accomplish rightfully and should not be oversimplified. There are variables such as whether the tail is wagging from the root or from the tip, the frequency, speed, the direction of the wagging, and so on. To understand the general mood of the dog, a general interpretation of where the tail position is and whether it is wagging comfortably or excitedly can be helpful.

4.2.1.5 Strategies for Adaptation

For the adaptation of the dog to the home after adoption, experts see the most important role in human companions. Expert B states that prior to the adoption, people should be mentally prepared for a new life with the dog and possible issues they might encounter together. He emphasizes that since human companions will guide the dog in domestic life and living together, they should always approach the dog tolerantly during the adaptation process.

The first thing that experts remind is that there is no concept such as home in dogs. Expert B defines the formation of a sense of home for the dog as orientation. He explains that the first step is to establish a routine and stick to it. When the dog is taken out, walked, and returned home 3-4 times a day, and this becomes a successive behavior, the dog understands that it is its home or living area. The expert suggests giving the dog a certain space or room as a method to trigger and strengthen this sense of belonging. He states that putting its belongings in this room also increases the sense of belonging to that space.

4.2.2 Family Interviews

Through the interviews I conducted, I gathered data on the dog families' dog adoption processes, the problems they encounter when they start living at home with their dogs, their daily routines, the elements that their dogs perceive as positive and negative stimuli, the reactions of their dogs depending on the body part they are touched during human-dog relations, and human companions' views on technology about dogs. I would have liked to ask dogs their opinions about these points, however within the limitations of my species' communication skills, I have used the experiences and observations of their human companions' instead, to reach the insights that would be helpful for designers aiming to design for the same context.

As a result of the analysis of the interviews, I obtained some main themes. Figure 15 below presents the thematic map of dog family interview analysis.

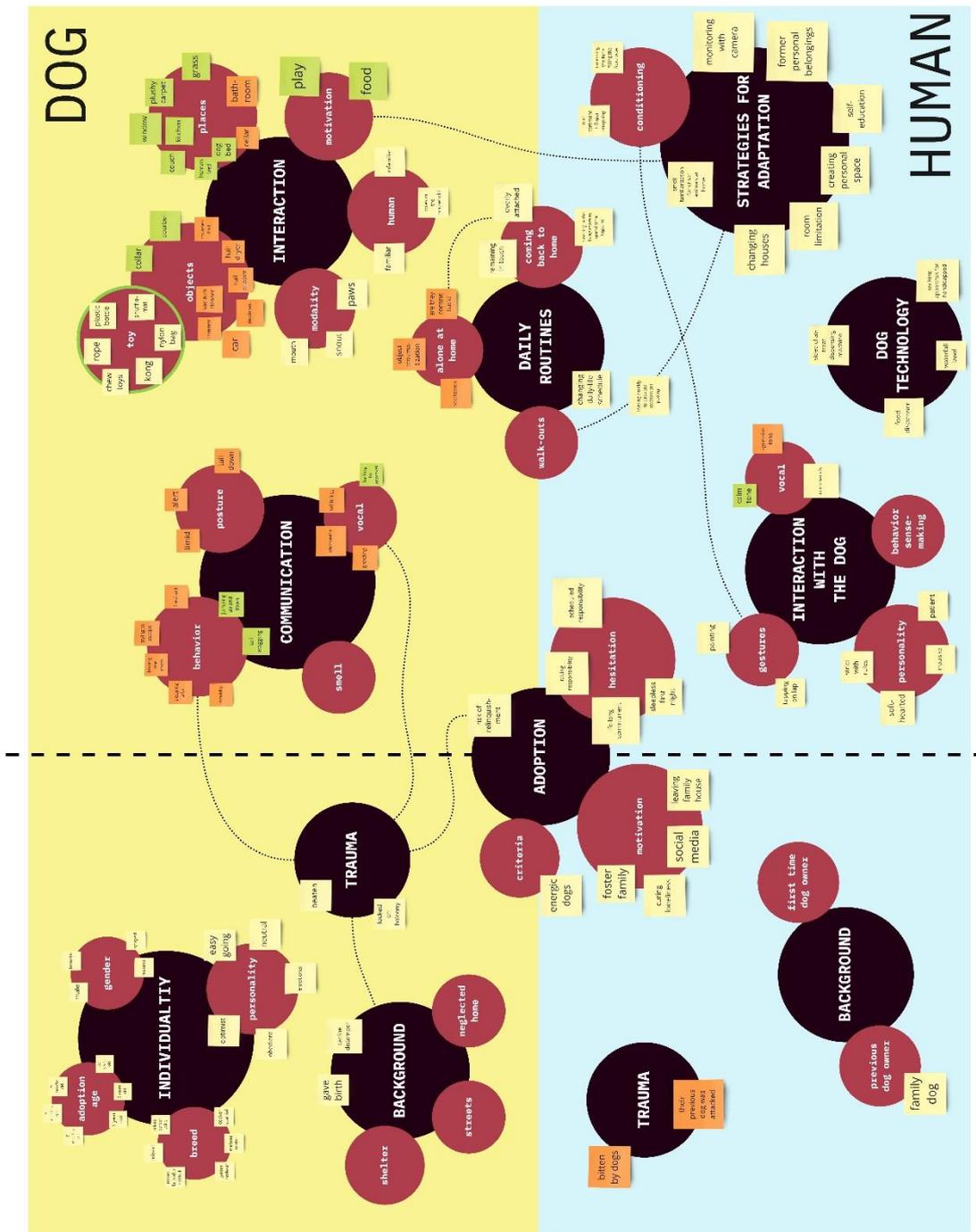


Figure 15 – The Thematic Map of Dog Family Interviews Analysis

In this section, I will share the insights I have reached based on these themes. Expressions such as D1, H2, which I used during the narration refer to the code-names I have used for dog and human participants in Table 4, which is presented in Section 3.2. I have supplied excerpts from the interviews to express and support the arguments better.

4.2.2.1 Background of the Dog

The journey of the dog, which we aimed as the primary user during the design process, does not actually start with adoption. The background of the dog directly affects both the process of being adopted and the life in the house after the adoption. This background, however, is not always accessible to the human companion. Except for the physical indications that can be observed during the adoption process, it is based on the interpretations speculated by the human companion over the dog's behavior in the house after being adopted and its reactions to different stimuli.

Physical clues such as earrings implemented on the ears of dogs placed in shelters by municipalities or scars left after the removal of the earrings give the concrete information that at some point in their lives, these dogs had been in shelters. These are the information given to the dog families by their veterinarians during their first examination before adoption. Family of D1 learns this and additional information about their first dog during that examination. They are informed that their first dog, D1 has given birth and the second one, D2, is a survivor of canine distemper disease.

Collection of this information is important in classifying the background of the adopted dog because according to the information given by the experts in Section Error! Reference source not found., the fact that dogs have come from a shelter, from the street, or from another home helps to explain some of their movements, fears or abnormal behaviors that they exhibit in the house.

4.2.2.2 Trauma of Dogs

A theme that is directly related to the background of dogs is trauma. The behaviors of the dog, whose past is unknown, can be interpreted depending on these traumas.

Family of D1 states that especially during the first days after the adoption, D1 exhibits a resigning position when they bring their hands close to her head. Similar observation regarding the hesitation of the dog is explained by the family of D8. She depicts that her dog waits for multiple approvals from her before starting to eat the food placed in her. Both families interpret these behaviors as a possible maltreatment during their pre-adoption life, or even a treatment including the usage of aversive training methods that might include violence.

These sensitivities are important for the designers, who will derive design alternatives according to the user profiles they will determine, in order to choose the stimuli to be avoided or the personal characteristics to be strengthened.

4.2.2.3 Individuality of Dogs

Realizing that dog users are individuals with different characteristics, just like human users, is an important point in terms of dog-centricity. The theme of individuality ensures that the primary users are understood and perceived with their whole unique features.

The dog's gender and neutering status can assist with the choice of physical activity and motivation to devise. Getting neutered affects the general mood and appetite of the dog. H8, the human companion of D6, explains the change as follows:

“We did not get him neutered, until he was 3 years old or something. Because of his instincts, when he got the smell of a female dog, he would pee everywhere just to leave a scent. We had a lot of trouble at that time, he was very aggressive then. The last period before neutering, he bit my nose. When we realized we could never cope, we had him neutered. The boy calmed

down. We had such a behavior disorder. His aggression was probably because of his testosterone. When he was neutered, he only got into trouble with his throat. It is not a behavioral disorder right now, but he is very voracious. All cockers are obese anyway. We try to keep him thin, but he likes home-cooked meals, misses food from the table, and hits the bread.”

A design solution in which neutered dogs are motivated by large amounts of reward food and remain immobile might adversely affect physical welfare. Because metabolic rate changes with neutering and when food intake is not balanced out with the physical activity, the risk of obesity increases as exemplified by H8.

It may be necessary to develop different solutions for adaptation to home life for dogs like D7, which is very active with high energy depending on the small age and the basic characteristics of the breed according to his human companion H9, and for dogs like D8, which is adopted at a later age and is acting inactive due to the emotional reflection of repeated re-homing. Inactivity of D8 is explained more in detail in Section **4.2.2.11.4**.

In addition to these, if during the design studies, the designers fine-tune their approaches to their dog participants by taking their character traits into account, more collaborative results can be obtained.

4.2.2.4 Background of the Human

Not only the dog's life but also the human companion's life prior to adoption affects the dog's welfare. People who have taken care of dogs (P2, P8, P10, P11) have an idea about the routine of living with a dog in the same house in general, although the character of each dog is different. Keeping that in mind, the designers must be aware that their target secondary users might have different levels of knowledge about dogs.

Adoption, where the dog and the human companion cross paths, is a vital point to start supporting welfare. The context of the design is adopted dogs living in the

house, hence the design brings solutions that will show its effect after the adoption stage.

H1 talks about her hesitation regarding the adoption of their dogs:

“I slept in the room with D1 the first night. I said ‘What have I done? What a big responsibility I took, what will we do, will we be able to cope with it?’ For example, D1 barked once or twice during the night when a dog passed by on the street, I thought ‘If these increase or if we cannot find a solution, he entered my house right now, even if he stays at home for one night, I can't leave him on the street for the second night, he has to sleep at a home all his life. But what will I do if I cannot?’ I have struggled with these thoughts all night in my mind. This feeling is gone by the second or third night. I said, ‘We have done a good thing!’ I felt the same again the first night for D2. ‘What if they do not get along?’ That feeling passed to in at most fifteen days.”

H3 shares the similar hesitation she goes through the first day. H4 talks about the awareness coming to him after adoption about the lifelong commitment. While shaping the solutions, these reservations should be accounted by the designer to increase the dog's adaptation to living in a house so that the bond between the dog and the human is strengthened and the possibility of negative scenarios such as the abandonment of the adopted dog is reduced.

4.2.2.5 Interaction

In my interviews with the dog families, I gathered the most data in the interaction theme on the dog's side. The theme of the interaction of the human companion with the dog was also a supporting theme. The dogs' interaction with different objects including toys, their approach to places in the house, the modalities they use during the interaction, the change in their reaction towards humans based on the level of

familiarity, and the motivation methods for interaction provide insights that will directly affect the design.

4.2.2.5.1 Interaction - Objects

The objects that dogs interact with within the house are mostly based on vision and sound in terms of the type of stimulus. The absence of smell on these comments may be due to the limited olfactory capabilities of the human companion. The obvious comments regarding smell are the smell of food and objects having the scent of the human companion such as pillows and t-shirts. H14, dog family of D11, exemplifies his reaction regarding olfaction as below:

“He comes running especially when I take out cheese. When we put a meal, he tries to smell the whole air when there is a dish he does not know. It is like he is trying to perceive the world through smells the most. When H13 is not in bed, when he goes to a conference or something, he always sleeps on H13's pillow. I put H13's t-shirt a couple of times when he went to the conference, D11 probably feels safer with his scent.”

In terms of sound, thunder is a very triggering negative stimulus for the dog with a street background (D10's experience is explained in detail in Section **4.2.2.11.5**). As for household appliances, there is no common result among dog participants. Dogs are generally uncomfortable around devices such as vacuum cleaners and hair dryers, according to the human companions' answers. This discomfort may be related both to sound and vision. The level of discomfort ranges from changing the room upon seeing the device, to not showing any discomfort until the device comes nearby. Dog families state that their dogs respond to visual and auditory stimuli of objects according to the associations they make. For example, the sound of a doorbell has a positive effect on dogs in general (D1, D2, D3, D6) because they associate the ringing with someone coming home according to the observations of their human companions. Seeing objects such as fur trimmer or nail clipper regarding their own

body care is enough for them to react negatively (D11). Seeing the collar, which they associate with going outside, creates a common joy response in all dogs. Rope, plastic bottle, or any material that they could chew on turns the object itself into a toy for all dog participants. One important criterion here is the durability of the material. If the material cannot withstand the dog's varying degrees of strength and breaks into pieces, it creates a risk of suffocation after swallowing. Another factor that causes dogs to leave their toys is that the novelty effect of the objects is gradually wearing off. The dog's urge to explore disappears and does not want to play with it anymore. In order to prevent this and to involve different senses in the game activity, human companions use food integrated toys such as KONG and snuffle-mat. The smell of the food in them becomes the primary stimulus for dogs and appeals to their natural behaviors such as sniffing and pawing during the interaction. They keep the dogs distracted for a long time because it takes a long time to reach and finish the food inside. H13 explains D11's experience with such an object as follows:

“For example, we bought KONG. Normally, dogs spend a lot of time with it, tossing around and passing hours. It is not like that for D11. He finds a corner, it's like dogs pass time, toss around, pass hours, but it's not like that for D11. After finding a corner, he squeezes KONG between both paws and finishes in ten minutes. In fact, he uses his paws very well with this kind of bone shaped objects. The thing with KONG is that it would keep the dog busy for a long time. To extend the time he spends, we were filling KONG with yogurt, putting it in the freezer and freezing it. It still takes fifteen minutes for him to finish it. He lies down, grabs it with his paws like a bottle and finishes it. For other dogs here, their humans say, ‘My dog plays with it for four hours-five hours’.”

Some other interaction examples that are common to all the dog participants based on their human companions' observations are their happiness when they see their human companion, the positive influence of soft and low voices of the human companion, and the negative influence of harsh and loud voices of the human companion.

4.2.2.5.2 Interaction - Places

The places where dog participants interact in the home vary, as well. Some examples they find positive are sitting in front of the window where they can watch and bark at the dogs or familiar people passing by (D8), lying on a plush carpet in cold weather or cold hard floor in hot weather (D6), sleeping on the bed where human companions sleep or on the dog beds specially bought for them (D1, D2, D3, D4, D11), the living room where they can spend time with their human companions (D5), the room where their food is given (D3) or the kitchen where the smell of food comes from (all of the dog participants that are allowed to go into the kitchen).

They all have a negative attitude towards the bathroom, where their paws are cleaned and washed at regular intervals after daily walkouts, and as their human companions defined “They put up with it.”. When cleaning is completed, they immediately leave the bathroom.

Another example of a place they avoid is the cellar. D8 does not even come near the cellar, and her human companion H10 links this behavior to possible negative traumas in the dog’s unknown past. The fact that there is food and treats in the cellar and their smells come from there do not cause any change in the dog's movement. H10 explains her effort of carrying the couch, which D8 loves to spend time on, to desensitize the dog, ends up with the dog no longer interacting with the couch.

4.2.2.5.3 Interaction - Modalities

When exploring the objects with which they will interact, according to the observations of their human companions, all the dog participants approach primarily by sniffing with their snout area, according to their human companions. Some of them additionally lick the object. They only start using their paws if they would like to open the object or physically restrain them to keep it steady. H8 explains his dog’s usage of the modalities for exploration as below:

“Directly smelling. Discovering with his nose. That is basically it, he does not go further from there. Does he try opening something? Yes of course, with his mouth. He usually tries to squeeze it between his mouth or paw and open it with his mouth. Breaks into pieces, I should say. But if he is not comfortable with the smell of it, and decides that it won’t open, he does not bother with it. But, for example, if you throw the plastic bottle in front of him, its voice does something to him. He starts hitting it with his paw, squeezes it, breaks it with his mouth, and then smashes it. He also tries to smash his toys in the same way. In fact, sometimes he gets really stubborn and if he sees that it is breaking apart, he continues until he breaks it down. When we give toys that cannot be broken, he quickly becomes disinterested because he could not succeed in breaking it down.”

4.2.2.6 Motivation

Human companions use one of the two primary motivations when they want to motivate their dogs to start or stop interacting with something. These are play and food.

Human companions use play activity to divert their dog’s attention when the dog starts object traumatizing the couch (D3).

For the case of the dog exhibiting inactive behavior during the adaptation process to the house and its people, H10 tries to use the toy she bought for her dog. When D8 is afraid to approach the toy, the human companion uses treats for her dog to interact with the toy.

Another human companion applies similar usage of treats to teach his dog new commands (D11).

It is necessary to consider food as a general phenomenon, rather than limiting it with treat rewards. Because food occupies an exceptionally large place in the life of dogs. Dogs respond to the smell and taste stimuli of all food without showing much

discrimination. Having said that, human companions observe their dogs have palatal delight when it comes to food. Some of the dogs' favorites are dairy products such as cheese and yogurt (D9, D10). While some do not like fruit even though they try (D3) it, some have their favorite fruits like watermelon (D7). While some do not eat vegetables (D2, D4), others eat every meal with onions in sauce regardless of the content (D6). A general commonality is that they all love meat varieties.

4.2.2.7 Reaction

Dog families I have interviewed with observes their dogs' reactions to people they interact with depend on whether that person is familiar to them or not.

The type of interaction with human companions in the house is determined by the roles in the household, which are shaped according to the dog's perception, although this may be an example of the aforementioned anthropomorphizing on human companions' side. These perceived roles may be depending on the approaches of human companions towards their dogs based on their personalities.

While some human companions are strictly rule-based according to their own descriptions (H2, H4, H8, H13), others describe themselves as more soft-hearted. Another factor in the determination of the role might be the share of activities performed between human companions in the same household, such as feeding the dog, taking the dog out for daily walks, and cleaning after coming home. H10 explains this role distribution among the household as below:

“Well, since I had responsibility of the feeding and taking to walk, I became to the D8 what my mother was to our previous dog. She kind of depends on me. But they are fine with my mother. You know, they are like two people living in the same house, more like they accept her that way. My father is exactly the same. They go out to the garden together. By the way, it looks like she is trying to ingratiate herself to my father. She barks a lot when she is in the garden with my father. It is like she is trying to say, ‘Did I do it right,

I protected this place, it is a good job, right?’. She is aware of his role, so she sees him as a father.”

These approaches may be guiding features for alternative design solutions where interaction is not completely initiated by the dog and the human companion is included as well.

4.2.2.8 Communication

Another important emerging theme for dogs is communication. Dogs communicate using their behaviors, body postures, or voices to react to any stimuli or to express something to the human or animal they are encountering. These are the elements of communication that human companions can observe. Examples that could introduce constraints to the design might be the dogs being hesitant when crossing a doorway, sleeping excessively, or remaining inactive for longer periods than their normal routine, all of them are the reported behaviors of D8 by H10.

The dog's movements such as jumping, turning around, wagging its tail in certain ways when it sees the human companion, general body posture or different types of barking help the behavior sense-making of the human companion by showing the dog's mood at that moment according to their common answers in the interviews, and these provide beneficial insights to crease use cases to develop scenarios of interactions.

Smell as an element of communication is not easily observed by the human companions. Almost all of the human participants in the interviews stated that their dogs understand that they are coming from work, but how the dogs differentiate them from other humans is unknown to them. Sense of smell might be the deciding factor here.

4.2.2.9 Daily Routines

Daily routines, one of the common themes for dogs and their companions, divide the day into times spent together and separately, with basic activities such as going out for a walk to meet the dog's physical needs and spending time together after the human companion comes home from work. When dogs are alone in the house, behaviors such as object traumatization or barking with the possible fear of “Will they come back?” as defined by their human companions (H4) can be observed. Human companions make this observation through the physical evidence they see after the coming home (H3&H4), from the complaints of their neighbors (H11&H12), or from the cameras they buy to monitor the behavior of their dogs (H1&H2).

Dogs alone time at home is an area where the design can focus because the dog is the only user in the house to interact with the developed solution that could help to solve the observed behavioral problems. This has the potential of helping to alleviate problems such as the dog being overly attached to their human companions and not leaving their side after they arrive.

4.2.2.10 Strategies for Adaptation

In the theme of strategies for adaptation, I have gained information about the methods applied by the human companions for problems encountered after adoption. Observing with a camera is a method that human companions resort to in order to be informed about their dogs' activities while they are alone at home (H1, H2, H3, H4). They try to adapt the dog with the smells they are familiar with by placing the dog's formal personal belongings for the dogs coming from another home (H10). Another use of a dog's olfactory senses is the effort of trying to familiarize the new-coming dog with the scents of animals already living in that house (H1, H2). Strategies applied by human companions for dogs showing separation-related behaviors vary from creating personal spaces for themselves and to dogs in the house (H13, H14),

to limiting the access of the rooms in the house (H1, H2, H5, H6) or even moving to a larger house by (H3, H14). Another strategy independent of dogs and performed by human companions especially for the ones who do not have a previous companionship experience with dogs is to self-educate themselves on dogs by watching the videos of animal experts.

4.2.2.11 Welfare Issues

Dog families, when I ask them about the issues they have experienced with their dogs or observed that their dogs having, supplemented answers about varying issues, namely obesity, vocalization, object traumatization, inactivity, noise aversion and excessive attachment.

4.2.2.11.1 Obesity

In the interviews I had conducted with dog families, I have learned that families often resort to treats as a source of motivation for adapting dogs to the home or accustoming them to new toys. However, excessive use of such food can bring various health risks. When I asked what they did to change the dog's indifferent behavior towards people at home and home life after started living at home, H10 answered as below:

“Giving treats all the time. That's why D8 already weighed 11 kilograms from 7 kilograms. The dog trainer also said, don't be afraid, you can always give prizes. There weren't any toys left that I didn't buy. You know, we bought those KONG-type things that the food comes out as the dog bites. At the beginning, she was unresponsive when I threw it in front of her, but she started to get used to it with treats because she is a glutton. So, we did our best to keep the tail wagging. But I made her eat too much this time, it got out of hand. Because as we discovered her interest in food, we used it as a

family, so we walked from there. It worked, but then her health was at a bit of a risk this time.”

4.2.2.11.2 Vocalization

One of the most common complaints I encountered when speaking to families was vocalization. The frequency of encounters and the solutions they apply vary. Below are the excerpts I got from the interviews regarding the vocalization issue.

The human companions mostly have trouble realizing the issue, since it mostly occurs when they are out of the house. Upon realization, another challenge they experience is detecting the source that is triggering the vocalization. If they manage to find out the underlying reason, they try to bring a solution and make it permanent for their daily life. H1 shares her experience regarding the vocalization issue of their dog D1 as below:

“We had not heard of D1 barking at all until it was the fourth month, she started living with us. One day I saw it on camera. She was barking like crazy, without ever stopping. We were out all night, she barked constantly until we came back. She was barking while looking out the window, so it was obvious that she was barking at something outside. I think she heard some new dogs coming close to the window. The window of the balcony and the door of the balcony were open. The balcony is a glass balcony, so it directly receives sound from outside. Then after coming back to the house, we closed the balcony door so that she could not see out of the window and hear any sound. We all pulled the curtains down. Actually, at first, the first day, we closed the door to the hall so that she would not go into the room where she barked. Upon observing that she only barks at a certain location, we opened the door and lowered all the curtains. She stopped barking. And now, I still pull the curtains down when I am leaving, just in case something happens again, so as not to risk it. We do not want it to repeat and become a habit for her.”

Some of them, as in the case of H11&H12, try to solve the problem by aversive tools.

“D10 weighs 40 kilograms. It was really hard for her to get used to us, especially to the house. Our house is small, a one-bedroom flat. H12 also got used to it very hard. For almost a year, she pooped home, ate the seats and barked all the time. Our neighbor sued us. We finally won the case. Finally, they moved out. We are getting through it all. As a result, we came up with such a solution that at night, we put a barking collar on D10. Because when D10 barks, it reverberates in the whole apartment. Not so much when D9 barks so we never put a barking collar on her. Normally there are two bark collars at home. One is automatic and the other is remote controlled. We put it on D10 every night before we sleep.”

Other examples, the human companions try out for the solution of vocalization, is to distract the dog. Since one of the main triggering reasons of vocalization for dogs is witnessing the human companion to leave the house, H3&H4 go for a fundamental change in the routines of their dog D3:

“The first time we left him alone at home, he started barking after we left. When I get out, I lock the door. He tries to open the door after we leave, if he cannot open the door, he barks for a maximum of five minutes. It got less and less by time.”

“He barks until something else catches his attention. At that time, I start calling a couple of words via the camera. He gets silent while trying to figure out what is going on.”

“But he was also crying while barking. He was also barking while squawking. You were leaving the house feeling sad or uneasy. He started barking until we got into the elevator and went downstairs. Then, we just did not care... It continued like that either with caring less or we routinely returned home and tried to form a muscle memory. He does not even bark now. He is still trying to open the door. Upon realizing that we developed some solutions. On the

way out, we get him distracted and go out like that. We close the door of his room and prepare his food. He is already waiting in front of the door of his room while we are leaving. We open the door of his room, he runs in, we close and lock it and leave immediately. Just like that, he started to enjoy spending time in the room anyway. While he is busy with food and distracted, he forgets our absence. When he realizes, he thinks that they will come back and goes to sleep.”

4.2.2.11.3 Object Traumatization

Another common problem following vocalization is the object traumatization of the dogs. According to the experience the dog families shared in the interviews, it occurs when the dog is left alone at home. Family of D3 share their experience as below:

“At first, we were in a one-bedroom flat. After D3 arrived, we moved to a two-room flat. This was directly related to D3. That sofa smashing process had started in the one-bedroom flat. He was doing it as soon as we left the house. First, he smashed the small pillow, then smashed the cushions on which we were leaning. Then he took down the big pillows that we sit on, the floor of the sofa, and started to eat their sponges. The dog expert said, prevent him from seeing those pillows for a while. Since we could not prevent it in the small house, we moved to the two-room flat and left the other room empty. There was only a hard wardrobe, nothing to eat.

Normally, people think that the cage is a bad thing, but it is a good thing when the dog gets accustomed to it. The dog feels safe there. We got D3 accustomed to the room. At first, we pet him there, we always went there and gave his food. Gradually we put his favorite toys there. We did not just put the stuff in there and lock it and leave, we made him go there on its own. We were putting food in and closing the door. He was trying to open the door himself to enter the room. He is happy to go in there because he knows that

he encounters with good things when he goes in. His water and food are there, his bed is there. We go there to spend time with him when he is there.”

4.2.2.11.4 Inactivity

Another of the problems I observed in the family interviews was that the dogs were not active at home after being adopted, and that they did not establish close relationships with the humans at home. H10 shares their journey from inactivity to being responsive and active as such:

“Well, D8 was very still, frankly. While the dog expert was here, that first enthusiasm of discovery gave way to timidity. After a while, I started to carry her up in my arms, because she did not want to go up the stairs or anything. We gave her treats when she went upstairs. We took her out so that we could show the places that she has not seen yet. The adaptation process was too long. We saw gradual changes through 3, 6, and 9 months. The first 3 months passed with sleep; she slept all day as if she was sick. We did not want to disturb her freedom too much, so we let her sleep freely. After the second month, when we went out, her tail was up in the air. She started responding to commands when we said come and started to look when we call her name. Then, for example, when I called her name, as if she was striking an attitude, she would turn his head away. You know, she was unhappy living with us. She even tried to escape in between the first 2-3 months, you know, she ran away, I was very upset. Then, when we were in the 6th month, the tail started to be in the air a little more like this, she started to respond when we said come. At 9th month when she saw us, her tail started wagging, her unhappy state was over.”

4.2.2.11.5 Noise Aversion

Sensitivity to sound is a problem that is more common in dogs coming from the streets. The examples triggering this sensitivity in family interviews were given as sounds such as car sounds, engine sounds, weather-related sounds, fireworks or gunshots. H11&H12 share D10's extreme reactions towards specific sounds and how they deal with it as a family:

“If there is a storm, if it is coming, if it is raining, D10 gets very afraid of the sounds. Sometimes they shoot fireworks here, and she is very afraid of it. Then she goes to the toilet crying and hides. She also calls us to the toilet, forcibly. If we do not go to the toilet, she goes out into the hallway, looks at us, squeaks, cries, barks. On such days, we all go to the toilet together, we sit until the storm passes. We continue doing what we normally do at that time in the toilet. D10 then gets to sleep, becomes at ease. And we wrap her with something like this, we put a sheet or something so that it will be heavy on her and take away the stress.

Gendarmerie training center is also nearby. She is very scared when they shoot. D10 is very sensitive about it, D9 is not that sensitive.”

4.2.2.11.6 Excessive Attachment

In the family interviews, fear of being left or abandoned again is observed more in dogs that are thought to have a household history. This fear manifests itself in the form of excessive attachment to the human companion. Dogs always try to be around their human companions and express their expectation of attention constantly, in an overwhelming manner as the human companions depicted. H3&H4 explain their experience regarding the excessive attachment of D3, their thoughts about the possible underlying reasons and their effort for the solution as below:

“I think it could be anxiety or something. You are leaving and it is not clear whether you will come back. He is not sure if you are going to leave him. You do not know how your animal was before. Maybe someone just left him that way. Hence the animal got traumatized. He is afraid now. So, at first, he constantly wanted to see and feel your presence. He wanted you to touch him. ‘Touch me, let me feel it, let me know that you are here.’ Of course, he could not hang around by himself. He was always there for you, poked you with his paws. Now, for example, he is a little used to it. He started hanging out on its own. If you do not care... Look, I just looked in his eye, he came right away. But if you do not care, he's learned to spend time with himself. Now, for example, three or five seconds of touch is enough for him. After a little love, and then he goes away... He does not poke you all the time. He can do something completely different. He goes and sleeps there. Or he learned that he should not push too hard when he doesn't get a reaction from you. Previously...”

“We got used to him a bit too. If he bothers you a lot, for example, get up, turn your back, do not pay attention to him... So, we learned it gradually. When he reaches too high up to our shoulders, gets into our mouths, for example, we would stand up. We would go to the kitchen. Then he would stay by himself, asking what happened. He learned not to be so overwhelming.”

The results I obtained as a result of my interviews with dog behavior experts and dog families supplied very rich insights into the observations and experiences of the actors who play different roles in the adoption experience. By transferring these insights to the designers, I believe that I can raise awareness of the designers on this specific issue and contribute to their individual research and studies on the context.

CHAPTER 5

DESIGN GUIDANCE FOR IMPROVING WELFARE OF DOMESTIC DOGS

Within the scope of this thesis, I created a guidance for designers aiming to increase the welfare of adopted dogs living in domestic settings. This guidance comprises followable tips for different senses of dogs. While creating this guidance, I used the insights that I obtained from my two-staged research. The first stage was the literature review of ACI case studies and supporting literature, and the second stage consisted of interviews with animal behavior experts and dog families. My aim is for the designers to realize that dog users have differences compared to human users while constructing their research and design process, to determine the needs of the users correctly and to develop designs suitable for their perception and interaction with the world. In order for guidance to be effective, I determined a narrow context of increasing the welfare of the adopted dogs and focused on these in the stages of the thesis.

In the literature, there are studies that suggest guidelines suitable for different types and contexts for different design phases that the designer can benefit from in the design for animal users, however, a body of knowledge in a collected format that a designer can make use of for different stages of their design process is lacking. With this motivation, I created a guidance to help designers reach user-centeredness for their dog users by following the pointers given in related sections. This guidance does not aim to directly involve with the design process of the designer. It introduces the design features for putting the dog users at the center of the design and techniques to understand them. Even though open to development, I believe that this guidance creates a starting point for the collection of information that could help the dog-centric designs including dog users in the design process by reflecting their perspectives and avoiding humanization as much as possible.

For this purpose, the guide consists of three parts:

- In the first part, welfare, which is the main goal of design solutions, is discussed. In order to understand the good welfare that is aimed to be achieved with the use of the design solution, the definition of welfare is made, and the points that create negative conditions for welfare and increase positive welfare are introduced.
- The second part focuses on interaction modalities, which is the most important element in terms of interaction during design. The variants of these modalities are introduced, and the design requirements for each modality are given.
- In the third part, the evaluation methods of the emerging design with the dog, which is the user group, and the points that the designers can make on their own or with the help of the relevant experts in order to make sense of and interpret the interactions of the dogs during these evaluations are introduced.

The icons depicted in the legend below are used throughout the guide in order to clearly observe the traceability and the sources of the information presented.



Figure 16 - The Legend of the Guidance

Target audience of this chapter is the designers. For this reason, starting with the next section, narration changes to address the designers directly. The guidance is constructed such that, it can be used independently from the rest of the thesis. However, to fully benefit from the guidance, it is advised to make use of the interactive structure of it by clicking icons next to the related section to read the related thesis section further.

5.1 How To Use This Guidance

Welcome to the guidance!

This guidance is specialized for you to make use of during your design journey for improving the welfare of adopted dogs living in domestic settings.

To understand what welfare is and to visualize the end goal, Section **5.2.1** introduces you the definition of welfare for dogs.

First you have to decide which welfare issue you want to choose. It could be just one issue or combination of more than one issues. You will create a design solution for this chosen issue(s). Design challenges for improving the welfare of adopted dogs are presented in Section **5.2.2**. Explained issues can be based on the literature review, expert interview or family interview. By clicking the icon next to the issue description, you can go to the thesis section where the issue is handled in a little more detail.

After choosing the issue to be addressed, there is the next step where the interaction modality selection, which is the basic element for your design, and the design requirements specific to the modality of your choosing. These design features are provided in Section **5.3**. You can get more information about these modalities, visit the expert interview or literature case parts in the thesis where the design requirements come from by clicking the icons next to the explanations. As a further, detailed reading in-text references of the literature cases can help you out.

When it is time to introduce your design to your users for user testing, you can use the pointers in Section **5.4** to explore how you can incorporate your user population into your tests and understand them.

5.2 Design Challenges for Improving Welfare for Adopted Dogs

Before you start your design, you need to get acknowledged about the ultimate goal of your design and determine the boundaries of your design. This section offers a journey on the welfare route for this. The first station is to understand what good welfare means. From there we discover the welfare issues stated in the literature cases or in the interviews conducted with experts and dog families in the scope of this thesis. The last station is the section where we get informed about the welfare aids that could be promoted for better welfare.

5.2.1 Good Welfare

Dogs from different backgrounds start a new life with their human companions after adoption. Reaching a good welfare state for these dogs, in this novel routine, depends on the human companions' approach to them and their past problems.

Dogs coming from the streets, dogs with shelter background and re-homed dogs have different experiences. However, considering their welfare in domestic life after adoption, common parameters based on the findings of Fraser (2008) given in Figure 17 should be satisfied.

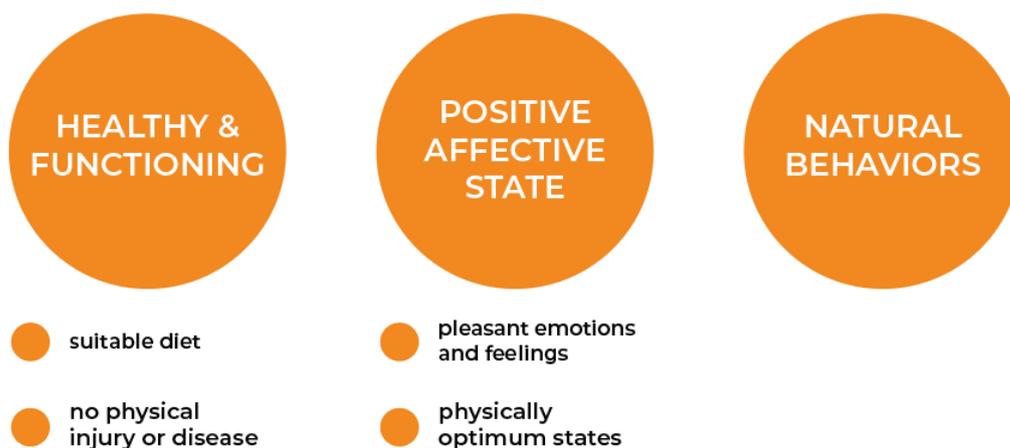


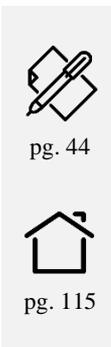
Figure 17 - Welfare Parameters

When human companions perceive their adopted dogs as a part of their family or as their close friends, it becomes difficult for them to understand that dogs have different sensory abilities and emotional capacities compared to humans. This misconception causes dogs to be humanized and as a result, while human companions approach to their dogs and interpret their behaviors, they put them in a human perspective (Rooney & Bradshaw, 2014). This is another issue creating an obstacle to achieve good welfare for adopted dogs.

5.2.2 Welfare Issues

Various welfare issues are introduced in this section for you to choose what you want your design to bring a solution for. You can tackle one or more of these at the same time.

5.2.2.1 Obesity



Food and various kinds of treats are effective motivation sources for dogs to teach a trick, introduce to a new toy or for overall adaptation to the human companions and new house life.

However, if they are overused and not balanced with exercises, they might cause obesity leading to additional physical and psychological health risks.

5.2.2.2 Confinement Distress



When dogs with different backgrounds are forced to stay in a limited area in the house, they show various signs of distress. For the signs that the human companion notices, such as house soiling or object traumatization,



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issue could be recognized, and solutions should be sought. However, for the not so observable signs, human companions need to carefully observe their dogs and seeks for alternative solutions.

It is important to supply a special place to the dog in the house. That could be a crate, a room or an area that is left to the dog by restricting the other areas in the house. In order to prevent the distress coming with confinement, the dog should be introduced to this place properly and gradually by the human companion, so that the dog can perceive the place as a safe area where it could eat, rest and play without any disturbances.

5.2.2.3 Vocalization



pg. 90

Especially the dogs coming from the streets would like to respond to every stimulus coming from outside by freely barking, like they did on the street.



pg. 116

It is specifically observed when dogs are left alone at home.

Blocking the dog from responsive stimuli, diverting the dog's attention and energy to a different pursuit can help.

5.2.2.4 House Soiling



pg. 90

Inappropriate elimination in the house is especially observed in puppies.

For adult dogs, it could happen as a result of sudden excitement or an illness. It is an issue that could be dealt with simple training.

5.2.2.5 Object Traumatization



Dogs can damage the house structure or the objects in the house mainly out of their curiosity to explore. Being not familiar with the concept of home for dogs coming from the street is also one of the factors.



If the human companion does not catch the dog during the incident and reacts to it later, dogs would be unable to build a relation why they are being punished.



5.2.2.6 Inactivity



Passive behavior in the form of sleeping or resting can be observed in the adopted dogs when alone at home or as a reaction for not being able to adapt to the household or home environment.



If it exceeds the boundaries of normal resting activity and becomes an issue adversely affecting the mental and physical fitness of the dog, cognitive or bodily occupancy should be supplied to the dog to balance their inactivity.



5.2.2.7 Noise Aversion



Especially for the dogs coming from the streets, sudden sounds could create critical sensitivity and result in panic attacks.

When they are alone at home, reactions of the dogs might amplify.



Human companions should keep their dogs away from these triggering noises as much as possible. Design solutions modifying the environment the dog lives in, or the behavior of the dog can help minimization of the dog reaction.



5.2.2.8 Food Bowl Aggression



For the dogs coming from shelters, past traumas not being able to reach to the food shows itself.

They need to be felt safe while they are given their foods or treats in order to let their guards down and surpass the territorial protection reaction.

5.2.2.9 Excessive Attachment



It is especially common in re-homed dogs. Dogs show excessive attachment to their human companions.



The dog needs to be made to feel that it is in a safe area and that it can have a good time on its own.



5.2.2.10 Other Welfare Issues

Other welfare issues experienced by the adopted dogs living in domestic settings have been identified in the literature and in interviews with experts as follows:



Pedigree Dog Breeding: Depending on the breed of dogs, they may have some problems in locomotion and breathing. These problems can cause them to fall behind in their daily activities and bring psychological negativity.



Personality Suppression: Dogs with shelter background show their real reactions to events and people after they adapt to their new home and new human companions. This can create problems in the bond between them.



pg. 92

Obsessive-Compulsive Disorder Behaviors: Dogs with shelter background may exhibit abnormal physical movements due to being in a closed cage and having limited opportunities for a long time.

5.2.3 Welfare Aids

Considering the welfare issues separately is an important start in understanding the reasons that bring them out. In addition to these, following general methods of welfare aids can help to emerge and enrich design solutions.



pg. 45

The human companion plays the biggest role for dogs who are entering a new living environment, to get used to the environment and establish their daily routines. Strengthening the bond between them and not harming this bond positively affects the dog both psychologically and hormonally.

Home life is a novel environment for adopted dogs regardless of their background. Although the re-homed dogs had a taste of home life prior to their adoption, they most certainly had a negative experience and came to another home. In this respect, introducing home life to the dog is a critical step. It is among the things that can be done to introduce the dog to the places where it can hang around comfortably, to determine the food and drink areas to provide routines, to arrange the dog-specific areas against things that might trigger them.



pg. 102

Minimizing the reactions that may occur with separation, especially in the interaction of the dog with the house or its human companion, will ensure that the dog has a balanced life pattern. In this step, observing the dog's behavior, getting to know the dog, and getting help from motivation sources such as food and toys will give positive results in terms of interaction and dog behavior.



pg. 114

5.3 Design Features for Dog Users: Modalities and Related Requirements

The key point that will guide your design is choosing modality for interaction. Depending on the welfare issue you choose to focus on, the design requirements you need to satisfy change accordingly.

5.3.1 Mouth



pg. 70

Choosing modalities suitable for dogs' natural movements will eliminate the need for extra training and initiate the dog's instinctive interaction.



pg. 93

Mouth modality is frequently used as in mouth grabbing and allows the dog's natural movements such as biting and chewing.



pg. 110

These movements trigger hormones and cause the dog to relax.

5.3.1.1 Size



pg. 70

The size of a design that the dog can grasp with its mouth should match the mouth size of the user group.

5.3.1.2 Shape



pg. 70

You should choose shapes such as oval, cylindrical tube that allow grasping with the mouth.

Choosing the shape as rounded helps to increase the activation area if there is a system to be activated by biting in the design.

5.3.1.3 Material



pg. 70

Choose a material that will be durable when dogs bite and chew for example rubber, or silicone rubber.



pg. 97

Durability should ensure that the product does not break into pieces.

Disintegration may create a health risk such as suffocation, as well as shorten the life of the product.



pg. 108

5.3.1.4 Taste

Dogs like to explore orally. You can use scents to increase this desire for exploration.



pg. 44

You can include food-related scents and flavors to increase the user's urge to chew.

By creating compartments in your design, you can put treats, which are one of the biggest motivations for dogs, into them.



pg. 94

Every dog has their own palatal delight. You need to choose a flavor that suits it.

You can try dairy products such as cheese and yogurt, fruits such as watermelon, vegetables with or without sauce to explore the taste of the user.



pg. 108

An easy and common option for dogs in terms of taste is meat varieties.

5.3.2 Snout



pg. 72

Snout modality usage is observed in two ways. The use of snout in accordance with dogs' nature is to serve the sniffing function. Another



pg. 93

usage seen in the literature cases is the equivalent of touching by hand in humans.



pg. 110

Experts state that smell is the primary communication channel for dogs, usage of snout for touching means blocking that channel.

5.3.2.1 Smell



pg. 28

Since smell is the primary communication tool for dogs, you can use different scents to convey different messages to them.

Remaining saliva from a previous usage on a design solution might distract the dog. If it is a system like a touchscreen interface where a target selection on the screen is aimed, impact of the left-over scent should be taken into consideration.



pg. 94

You can integrate pieces containing familiar scents into the design solution to trigger the olfactory memories of dogs and that could initiate explorative play sessions.



pg. 108

Usage of removable soft exteriors on the design solution would allow it to be washed regularly. It is both hygienic and an effective way of eliminating the remaining distractive scents.

5.3.2.2 Installation and Size



pg. 72

Depending on their breed and age, dog users can be of different sizes. Develop vertically adjustable systems to allow the usage of dogs in varying sizes.

If you choose snout to be the interaction modality, using surfaces parallel to dogs' nose can provide ease of use. Designing angularly adjustable systems offers calibration for different sized dogs.

For physically activated subjects, install your design solution at a location that dogs' flexibility abilities let it touch via its snout.

If you locate your design accordingly, dogs will prefer touching smaller objects with their snouts.

5.3.3 Paws



pg. 73



pg. 93



pg. 110

Dogs use their paws mainly for moving around, digging and gripping. Among most of the cases in the ACI literature, they are regarded as the counterparts of human hands. Dogs use their paws to physically restrain them to keep it steady, or to open the object in concern.

5.3.3.1 Installation and Size



pg. 73

For physically activated subjects, install your design solution at such a location that dogs' flexibility abilities let it touch and exert force via its paws.

If you locate your design accordingly, dogs will prefer touching bigger objects with their paws.

5.3.3.2 Material



pg. 73

For design solutions containing dynamic mechanisms manipulated by force exertion, be careful about the slippage. Choose the material or the surface finish accordingly.

5.3.3.3 Activation Force



pg. 73

If you design a system activated by force exertion, arrange the applicable force within the physical capabilities of dogs. While arranging, rather than maximum limits, choose a range within the comfort limits of the dog user population. Because dogs tend to stop trying to activate the system, if it gets harder for them to manipulate.

You can develop a system with a noticeable movement upon the activation to haptically inform the dog user.

5.3.4 Vision



pg. 31



pg. 95



pg. 108

Vision is not a directly chosen modality. However, it is the biggest factor in the perception of other modalities and the most frequently used modality in the ACI literature. One of the important reasons for this is that the primary sense of people is vision, and the design solutions are primarily driven out of this.

5.3.4.1 Color



pg. 77

Dogs can see colors ranging between blue and yellow. Colors between them appear to be blends of white. If you are developing a design solution where colors are used for discrimination, take this factor into consideration.

Especially for touchscreen interfaces or physically activated objects, color of the background is important for perceivability. If yellow or blue is used as the leading color for the virtual targets or physical buttons, try not to use hues closer to the leading color on the background in order not to make the component in the front indistinguishable.

Transparent background might create confusion for dogs, because no contrast is offered.

5.3.4.2 Shape



pg. 77

If you create a virtual target to be used in systems like touchscreen interfaces, you can choose regular shapes like circles or familiar shapes for dogs, such as ball or rat to resemble a toy or a prey.

5.3.4.3 Size



pg. 77

You should select the size of a target that the dog physically activates or virtually selects large enough for dog to distinguish.

If the size of a moving smart toy is too large, the dog may become frightened and unwilling to interact with it.

You should determine the smallest dimension of a smart toy by the compact assembly of sensors, memory cards and cables inside of it.

5.3.4.4 Material



pg. 77

A hard plastic or metallic outer material might not appeal to the dog since they are not appropriate for biting or grabbing by mouth. To eliminate this problem, you can use a soft cover such as faux fur to give the object a sense or prey.

5.3.4.5 Installation



pg. 77

In a visual system to interact with by touch, such as the touchscreen, your design solution should be at the dog's head level. Designing vertically adjustable systems offers calibration for different sized dogs.

For a system where the dog interacts only by watching, such as the TV screen, it is important to provide a comfortable usage experience, considering the usage time.

5.3.5 Hearing

Just like vision, it is not a modality that directly chosen. However, by acting as an input, it triggers the dog user and also can be used effectively for feedback purposes.



pg. 33

If you choose sound as a stimulus, you can make use of human companion's voice or the voice of other animals. However, you should carefully assess the effect of the chosen sound on the dog in order not to create confusion for the dog.

While using human companion's voice, record only small commands or reactions. Longer sentences might create confusion for dogs.



pg. 79

For the usage of human companions' voice as a stimulus, it should be noted that their voices sound different coming from the speakers. In order to eliminate confusion on dog's part, you should perform familiarity practices for the altered sound.



pg. 96

It is enough for the used sounds to be just audible because of the threshold of hearing of dogs. Louder sounds can be disturbing and directly affect welfare.



pg. 119

You can use the natural sound of the system that is activated by any means in your design solution as feedback to inform the dog participant.

For touchscreen interfaces, you can use a tone with changing frequencies as feedback for the selection of different virtual targets.

Since dogs associate sounds with activities, such as clicking sound of the collar with going out, sound-activity matchings can be used as in the design solutions.

5.3.6 Haptic Feedback

When touch is evaluated as active touch, it can be performed with any of the modalities of mouth, snout and paws, depending on the designer's choice.



pg. 34

When passive touch is concerned, mostly wearable design solutions are observed in the literature cases. The dog user does not actively interact with the design solution. However, such solutions are seen to be helpful in improving welfare. Since this usage do not involve the dog's active interaction, this point needs to be strengthened to ensure user-centeredness of dogs.



pg. 75

For wearable design solutions likes collars and harnesses, develop adjustable systems to fit different sized dogs.



pg. 97

Avoid installations of wearable design solutions on the sensitive areas of dog body.



pg. 110

If you develop a wearable solution giving signals to the dog user to create tactile feeling, you need to consider the type of fur the dog has and its isolating effect while locating the device on dogs' body.

5.3.6.1 Weight



pg. 75

For wearable design solutions, the weight of the overall system should not be in a level such that it restrains the natural movement of the dog and cause any physical discomfort or damage to the dog.

5.3.6.2 Safety



pg. 70

For the design solutions comprising memory cards or electronic routings, try to obtain a solid and compact system by using materials like hard plastics. It would prevent dog to directly contact these components and eliminate health hazards.

5.4 Meeting the Users: Participation and Behavior Sense-Making for Dog Users

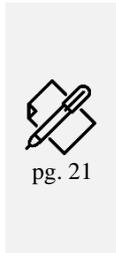
After developing your design solution, it is now time to meet with your end-users for evaluation. For user testing, this section firstly introduces you the different types of participation you can choose to include your target user group. When you come together with the dog users, it is important for you to collect data of their experience. To be able to collect interpretable data from your exceptional users, second part of this section provides you alternative sense-making methods for dog users' behavior.

5.4.1 Type of Participation

During the design activities, or after developing the design solution and presenting it to the dog user for it to interact with and evaluate, bringing the user itself to the process whenever possible might be a preferable method for you to witness their perspectives at first hand, or at first paw in our case. In the literature there are two

main ways for them to involve to the studies, training them for evaluation and providing playful sessions for them to participate.

5.4.1.1 Training for Evaluation



To assess the functionality of the design solution you have developed or to evaluate how well your dog user will embrace and apply the usage scenario you have determined, you can perform user tests with your target user population by giving them basic training specific to the goals of your study.

You need to pay attention to the following criteria while conducting user testing with the dog users:

- Make sure to protect your dog participants from any physiological or psychological harm during your sessions.
- Give them the freedom of withdrawing from the interaction any time they want. That could be giving a short break for physical needs or permanent withdrawal from the session.
- Supply resting areas and opportunities to relieve themselves.
- Make ready fresh drinking water and small treats that would not affect the course of your session and the health of the dog participant.
- Be careful about the temperature of the environment to avoid thermal fatigue.
- Use only positive reinforcement methods and avoid any aversive techniques or tools.

However, remember that in this type of participation, your dog users will follow the steps taught by training to reach the source of motivation, rather than reflecting their preference-based perspective. They will interact with your design solution; however, their exploration will stay within the boundaries of the scenario setup you guide them through with training.

5.4.1.2 Inviting to Playful Sessions



pg. 24

Since play is one of the motivation sources of dogs, you can create playful interaction sessions with your dog user.

These sessions will help you to create a common language with your user.

Make the sessions explorative as possible as without the limits of a strict scenario. That will help you to observe your user's honest reactions regarding its preferences.

Make use of different level of fidelity mock-ups to try out the different affordances offered by the mock-up.

5.4.2 Behavior Sense-Making

While performing sessions for user testing with your dog-users, it is important to collect data for the evaluation and improvement of your design solution. Since dogs and humans have obvious communication differences, this section gives hints about the methods you can use to make sense of their behaviors.

5.4.2.1 Interview with Humans



pg. 80

Since human companions of your dog users know their typical daily behavior, you can conduct questionnaires and interviews during different stages of your design process.

You can get information about the background of your users prior to design, or compare the changing behavior of the dog during the usage of your design solution.

To minimize the bias that might be unintentionally introduced by the human companions of dogs, prepare questions that could be answered descriptively.

While asking open-ended questions, search for the rationale behind the depictions. Probe them to objectively describe the behaviors, reactions and body languages they observe.

To obtain quantitative the answers, you can create Likert type scale questions to learn about the emotions your user displays.

5.4.2.2 Ethograms

To standardize your observations regarding the dog's body language, you can make use of ethograms.

An ethogram is a list of different types of behaviors for a certain species. It provides a detailed account of a variety of natural activities.

Using an ethogram allows you to define your dog's observable behavior in common words without relying on subjective interpretation.

Depending on the goals of your design solution, you can define and expand the scope and content of your ethogram.



pg. 84

5.4.2.3 Collecting Body Data

Depending on your design solution, you can benefit from the direct input coming from your dog user as feedback.

To achieve this, physiological indicators are collected from the dog body, such as cortisol levels for observation of stress. Collection and analysis of the data require collaboration with experts.



pg. 82

Interpretations based on the body language of dogs might introduce human bias. Hence, additional quantitative inputs might be useful for validation.

While choosing data collection methods, select them carefully to preserve the welfare of your dog participant.

5.4.2.4 Collecting Device Data

Physiological indicators are not the only way to collect quantitative data.

You can directly collect data from the technological devices you use or develop in your design solution.



pg. 83

Data collected with the design solutions give quantitative results depicting different directions of the realized interaction such as success ratio, execution of the planned movement etc.

Based on these data, you can assess your process and develop your design solution iteratively as you like.

5.4.2.5 Expert Observation



pg. 82

Since you are working with specialized users, consulting or collaborating with experts specialized in these users make your design solution more user-centric and credible.



pg. 98

For making sense of the behavior you observe during your usability tests, addition of an animal behavior expert specialized in dogs to the team could help you to emphasize more with your target users.

CHAPTER 6

CONCLUSION

This chapter concludes the studies conducted in the scope of this thesis by assessing the extent in which the aim of the research is achieved.

6.1 Revisiting the Research Questions

The key research question of my thesis is “How can designers be guided in designing for improving dog welfare?”. I have divided this key research question into two main questions.

The first main question “*What are the design requirements for designs aimed to improve the welfare of dogs in domestic settings?*” is supported and investigated with the following two sub-questions:

- Answer to the first question of “*Which interactional characteristics of dogs should be considered by designers to center dogs in the design process?*” formed by my results coming from three different sources. The first source, my case study review in the ACI field, showed that researchers design their interaction studies based on the senses of dogs. Inputs coming from these senses are perceived by different parts of the dog body. During the selection of modalities based on these body parts, I have noticed some anthropocentric approaches that are disregarding the usage priority of the modalities in dog’s nature. One of the examples is choosing snout to be used for touching, but not smelling. Another example is that although the sense of smell is the most important sense for dogs to make sense of the world, human researchers and designers were mostly focused on the vision, mostly because of the human perception. The second source, the expert interviews, supported this

observation as well. Experts explained sensory abilities of dogs that are forming the main interactional characteristics. The third source, the family interviews, strengthen the results obtained from first two sources by the experiences of families with their dogs. Families shared their observations on how their dogs interact with the world. Overall deduction of the results show that senses are the leading factors forming the interactional characteristics of dogs. For dog-centricity, designers should build scenarios of interaction base on how dogs use their senses naturally rather than how humans perceive dogs' senses.

- “*Which design parameters are effective for improving welfare of dogs in domestic settings?*” sub-question focuses on the welfare and life at home. To be able to determine the related parameters, I have conducted a literature search about dog welfare. It includes the definition of welfare, welfare issues encountered in animal studies and strategies for them, and the welfare issues arising due to the anthropomorphism of human companions towards their dogs. After literature review, in my interviews with experts I have collected data for main welfare issues seen in the adopted dogs related to their background and the possible adaptation strategies for these issues. Through the interviews with dog families, I have directed questions about the background of their dogs, welfare issues they observe and their strategies for solving these. According to my results, I have seen that the major welfare issue affecting adopted dogs in their new lifestyle dynamics is separation related issues. With the traumas coming from the past, majority of the adopted dogs suffer from separation related distress. This triggers other welfare issues as well. Behaviors as a result of these issues define clear problems that the design solutions can focus on and be helpful for. While defining the design requirements, refinement of the requirements should be done critically by taking the trauma related triggers for dogs into account.

Second main research question “*Which considerations should be taken into account in the design process for designing for dogs?*” has the following two sub-questions:

- Answers for “*What kind of a process should be planned for research and design phases to include dogs’ perspectives?*”, mainly came from my literature review of ACI case studies. Theoretical side of the ACI field .constantly looks for the answer for this question, generalizing it to whole species of animals. It was critical to understand the main communication problem between humans and dog participants. I have explored how the dog participants are included into the studies. Non-participatory and participatory involvements of dogs give different level of opportunities for the perspectives of dogs to be integrated into the design process. Non-participatory methods are mainly used for evaluation of the functionality of the developed design solution. They show the compatibility of solution’s affordances with the dog’s capabilities. However, individual perspective of dog participants cannot be integrated into the process, because they perform what they are trained to do with the motivation of treats. Participatory methods offer more chances for dog’s preferences to be heard. Playful exploratory sessions help designer and dog user to meet on a common ground and interact together with the developed design solution. Another important factor in all of these methods is for the designer to understand the dog behavior. For behavior sense-making methods, the case studies in ACI field, reveals two main branches. First one is qualitative data collection, which is performed mainly by observation and/or conducting interviews with human companions or experts. For subjective depictions, ethograms associating the body language of dogs with their behaviors are used. Second branch in the case studies for behavior sense-making is collecting quantitative data from developed solutions or directly from the body of the dog. The latter one must be performed in collaboration with experts in order not to harm the participant. However, quantitative data is not enlightening enough by itself. Hence, it must be put into a context with qualitative methods. In addition to the method used in the ACI cases, I have consulted experts’ opinions and experiences as well. Even though it is a completely vast

field that they spend years to understand and excel in, they have pointed out some general implications to be used in design studies. According to their explanations, the posture and behavior of dogs might have various underlying reasons, hence might indicate different results. However, they have added that it can be easily seen whether the animal is in a neutral emotional state or triggered by something, either positively or negatively, by observing their body language, parts of their body like tail and ears.

- Last research question of “*Which differences of dogs compared to humans should be paid attention to?*” is mainly about the physical and cognitive features of dogs. My literature search on the sensory abilities of dogs from the animal studies field revealed descriptive and factual information that is useful for designers. Design requirements appropriate for the usage of dogs derive from these features. However, differences between humans and dogs are more than just physical facts. Perception of humans towards dogs plays an important role in the realization of differences between these two species. As a results of my interviews, I have realized that making distinctions between human user and dog user, starts with treating the dog user as an individual. Physical features help shaping the general usage scenario and affordances according to the capabilities of dog user, however understanding the world through their eyes and empathizing with them becomes possible by learning their backgrounds, motivations and reactions towards the stimuli that might not even be perceivable for us humans.

6.2 Beneficiaries of This Study

Design researchers and designers who are interested in multi-species studies are aimed with this thesis. It is important for them to be aware of the limitations of the existing research and design methods for animal participants. Even though the choice of species and context to study might completely change the course of action to be taken during the plan and conduction of the research and design, one of the goals of

this thesis is to raise the awareness of how different studying with animals can be compared to human participants. For researchers and designers choosing to study with dogs, this thesis presents species-specific challenges and possibilities. Using the guidance would hopefully be illuminating for designers targeting dog users in domestic settings.

6.3 Limitations of the Study

The biggest limitation of this study is that I was not able to consult the dogs themselves during the collection of data. Even though this thesis study is not generating any design solution and is about guiding designers for the formation of design requirements prior to design and for the evaluation of the developed design solution, it would have been more dog-centric to involve the dog participants to the process.

However, I have made use of ACI cases where dog users took place as participants. I have tried to critically review them and compare them to the ones that are not including dog participants to sort out the points that are not satisfying dog-centricity with the rationale behind. I have consulted the experts directly studying and working with dogs via interviews prepared specifically to reveal differences of dogs compared to humans. I have constructed my interview questions for dog families such that I could collect data for instances of interaction of dogs during everyday life. Even though serving secondary opinions, experiences and recollections of the dog families showed the process of adoption and life of dogs after adoption. I believe that effective outcomes from these data have emerged for helping the designers to reach for user-centeredness for their dog users.

Another limitation was that this study targets a specific context, domestic setting, and hence eliminates the other contexts that are parts of a dog's daily life, such as routine walks outside of the house or garden encounters. In order to reach a full user

experience for dog users, these areas of exploration can be studied to enrich and support domestic life experiences.

6.4 Future Studies

The guidance as the output of this thesis study can fully serve its purpose when the designers who are interested in interspecies interaction benefit from it. To satisfy this, the guidance needs to be communicated to them. At this point, further studies regarding the guidance to be a stand-alone product itself come into place. Decisions concerning the design of the design guidance and its delivery to the designers form the future studies that is intended to be worked on. I aim to create an interactive and open to development design that will be available for designers to use through a physical, online or hybrid medium. I also intend the guidance to be more sustainable with the contributions of different stakeholders. The animal behavior experts, dog families and designers can share their inputs for the guidance through the designated medium. After certain filtering and modification of the filtered input to meet with the standards of the language of the guidance, new data can be integrated into the body of information. In this way, the guidance would be an expandable structure growing with such contributions.

The guidance tries to embody a collection of knowledge regarding dog perception and domestic experiences of dogs. For it to be used in design studies, the support of animal behavior experts to review and refine it would be a helpful step. Such a revision would verify the shared information and suggested methods. Such a multidisciplinary study would increase the credibility of the guidance, as well.

Following the collaborative effort with animal experts, it is important for the guidance to be tried out by the designers to evaluate the effectiveness and detect lacking features. As a follow-up study, a series of workshops based on the usage of the guidance with a number of dog participants can be performed. During these

workshops, designers preferably with no background in designing for animals can try out the guidance and give fruitful feedback to develop the guidance.

Additional possible future studies could be performed by developing parallel guidances for different contexts to improve the welfare of dogs. Obtained guidances would be clustered into a comprehensive guidance to be used for the overall improvement of dog users. This species-specific study can be adapted to be performed for other species, as well.

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APPENDICES

A. Type of Technologies Studied in the ACI Literature

Source	(Mancini et al., 2012)	(Nelson & Shih, 2017)
Study	System: Collar with location tracking device Aim: To understand context-based meaningful interactions between humans and their dog companions	System: Collar with location and health tracking device Aim: Informing human companions of dogs about dog's daily caloric balance, exercise, and movement habits with a personal information visualization prototype
Type	Wearable Technology	Wearable Technology
Type Of Interaction	Passive: Wearing Visual: Seeing the collar before wearing Auditory: Hearing the clicking sound when owner is strapping it	Passive: Wearing
Physical Design Parameters	N/A	N/A for dogs. Design decisions regarding UI are for human companions.
Features Of the Animal	Conditioning the dog with visual (sight of collar) and auditory (clicking of collar when strapping) cues	Dogs' physical parameters are entered to device for calibration
Behavior Sense-Making	Interview with human companions after field study of collar usage	Quantitative analysis based on the data collected from the collar Interview with human companions after field study of collar usage
Type Of Participation	Free-will	Free-will

Source	(Jackson et al., 2015)	(Valentin et al., 2015)
Study	System: Sensor equipped harness Aim: To provide dog-to-handler interaction for working dogs	System: Collar with sensors Aim: Overcoming informational asymmetry between working dogs and their handlers through head gesture-controlled dog-to-handler communication
Type	Wearable Technology	Wearable Technology
Type Of Interaction	Head gesture for proximity sensor Biting via mouth usage Tugging via mouth usage	Head gestures
Physical Design Parameters	Material: Dog toy appearance with black rubber Shape: Rectangular for bringsel reminiscence / Oval for increasing sense activation area / Compact and enclosed for safety to eliminate strangulation, catching onto obstacles and waterproofness	Weight: Should not impact the performance of head gesture Material: Selection should be based on the dog coat type for sensor to stay in its intended place
Features Of the Animal	Location of the sensor is based on the flexibility of the dog / Harness is adjustable for different sized dogs Border collies learned activation of proximity sensor easily compared to others, Dogs prefer more concrete affordances and cues compared to abstract ones	Location of the sensor is affected by the type of coat dog has Different body sized/flexible dogs should easily perform the gestures physically Dogs should easily understand, learn, and remember to repeat the taught gestures
Behavior Sense-Making	Quantitative analysis of training time, dog and sensor accuracy, sensor reachability, overall success, and false-positive rate metrics	Quantitative analysis based on the data collected from the collar
Type Of Participation	Training: To teach motions (hand-target, retrieve, tugging) for activating sensors with shaping using food as reward marker for positive reinforcement	Training: To teach gestures for activating sensors with target stick, target toy and cookie stretches as a form of luring

Source	(Byrne et al., 2017)	(Resner, 2001)
Study	System: Harness with sensors (haptic interface) Aim: Satisfying handler-to-dog communication with sensors that is delivering vibrations in different power levels for the cue supplied by the handler	System: Webcam to show the state of the dog to the human companion, speakers for dog to hear the clicking and human's voice, after the dog displays trick behavior by touching the wired alley-ooop or squeezing the toy panda human activates the treat dispenser for dog to eat and gives a verbal praise through the speakers
Type	Wearable Technology	Physically Activated Objects
Type Of Interaction	Touching via paws and nose for reporting behavior during training Passive: Sensing vibration	Hearing: Hearing the human and clicking sound through the speakers Hearing: Sound of the squeeze toy Touching: Touching the tip of alley-ooop or squeezing the toy panda Taste and Olfaction: Smelling and eating
Physical Design Parameters	Size: Adjustable harnesses across the dog's chest to be able to respond to varying dog participant sizes / Location of vibration motors: To the tuft of fur above shoulder blade center for comfort and convenience of dog, and safety reasons to avoid entanglement due to the cables	Environment: Quieter and more controlled home environment showed better results than the dog training center.
Features Of the Animal	Different coat types and densities affect the sensed vibration Stimulation of vibration might evoke negative experiences from past with vibration/shock	Due to difference in hearing with the dogs, what dogs hear from the speaker might not sound like the human companion. Personality traits: One participant was curious and animated. His excitement focused on the feeder, and no link was built with the auditory stimulus.
Behavior Sense-Making	Observation Quantitative analysis of dog response rate and accuracy	Reporting of human companion and professional dog trainers based on video recording observations
Type Of Participation	Training: To report behavior after sensing the vibration with classical conditioning using a reward marker, a clicker or a verbal cue	Training: Clicker training

Source	(Ruge & Mancini, 2019)	(Geurtsen et al., 2015)
Study	System: Access control to open motorized doors Aim: Creating means of systematical evaluation for animal usability taking into account of user's physical, cognitive and sensory characteristics with the specific user group of mobility assistance dogs	System: Two buttons on the floor in front of two speakers and a treat dispenser in between them giving treat when the dog presses the correct button Aim: Entertaining the dog with an interactive digital hide and seek game initiating the play without need of a human
Type	Physically Activated Objects	Physically Activated Objects
Type Of Interaction	Nudging with snout (nose)	Hearing: Audio sample from the speaker to initiate game Touching: Touching the button with paws Eating treat from the dispenser
Physical Design Parameters	Material: Metal vs plastic Color: metallic grey vs bright blue and yellow Finish of interaction surface: smooth vs lightly textured Activation force: firm vs soft Activation sound: just audible clicking noise vs loud one Installation options: fixed vs adjustable	Material: Flexible plastic sheet cover Activation force: Minimal (a weight of 70 grams is sufficient) Stimuli: In form of audio of the dog's human companion
Features Of the Animal	N/A	Cortisol collection: Saliva, Personality traits: Depending on the breed, some dogs are in need of mental stimulation and known to be active, hence game is more suitable for them
Behavior Sense-Making	Analysis of video and audio recordings of the trials	Quantitative analysis: Measuring physiological indicators, cortisol levels as hormonal indicators of stress Video recording Quantified ethogram production based on qualitative analysis of videos and notes
Type Of Participation	Training	Free will No training to touch the buttons Positive reinforcement with food reward when the task of touching the correct button is achieved

Source	(Mancini et al., 2016)
Study	System: Operating switches for access or light buttons Aim: Understanding which design principles applied in interaction design is more relevant when designing for dogs
Type	Physically Activated Objects
Type Of Interaction	Touching: Nudging with snout or pushing with paws
Physical Design Parameters	Size: Small ones do not stand out Material: Plastic is preferred. Metal is hard and slippery. Activation force: Harder ones make dogs to try stopping Background color: Transparent backgrounds offer no contrast and create confusion Color: Yellow button on creamy wall creates no contrast and less perceivable Texture: Lightly rough texture offers better feeling under the paws Movement of switch and clicking sound on activation as feedback
Features Of the Animal	Using background support to jump up (stand-alone pillar is challenging because there is no room for support) Big dogs had trouble for reaching and jumping to lower placed buttons Jumping affects dogs' hips and back legs. Accessible length for nose is better due to less constrained and more accurate head movements Learning: Learning to operate switches hard. They are doing the task (or any task) to get the reward food. Feedback: When there is no feedback, dogs easily get confused
Behavior Sense-Making	Qualitative analysis with observation and human interviews
Type Of Participation	Training for switch usage

Source	(Mancini & Lehtonen, 2018)	(Ruge et al., 2018)
Study	System: Operating switches for access or light buttons Aim: Exploring which principles of interaction design might be relevant for dogs and if multiple principles can be used for interfaces that dogs come across with in daily life	System: Access button to open motorized doors Aim: Using tail wagging for evaluation of dog interaction in a task they are good at/proficient
Type	Physically Activated Objects	Physically Activated Objects
Type Of Interaction	Touching: Nudging with snout or pushing with paws	Touching: Pushing button with snout or paws
Physical Design Parameters	Color: Yellow and blue Shape: Square with protrusion from the mounted surface / Installation location: One on top of the other with a distance apart / Size: Smaller door-opening controls are at the snout touching height, the ones turning on the lights above them are larger	N/A for dogs. Design decisions regarding UI are for human companions.
Features Of the Animal	N/A	Tail wagging with all its forms is characteristic to the dog and can be correlated with their personality assessments.
Behavior Sense-Making	Video recording for qualitative observation and usage of ethogram for analyzing the observed behaviors	Personality assessment with MCPQ-R Video recording for data analysis Quantitative analysis of tail wagging parameters Grounded theory to create tail wagging ethogram
Type Of Participation	Training: Positive reinforcement with food markers, verbal cue "touch" and pointing gesture to the switch	Training: Positive reinforcement and clicker training for motions triggered by push, nudge, pull and retrieve commands

Source	(Mancini et al., 2015)	(Baskin & Zamansky, 2015)
Study	System: Pressure sensor supported metal plate assembly with cell samples on the surface Aim: Creating an interface for cancer detection dogs to use for signaling	System: A tablet for playing a game in which prey-looking objects are in motion Aim: Analyzing and interpreting play behavior of dogs with digital games
Type	Physically Activated Objects	Touchscreen Interface
Type Of Interaction	Touching with snout (sniffing and/or licking)	Eye-tracking the virtual targets and head twisting / Catching the virtual targets by teeth / Scratching, pushing, and licking the tablet/ Jumping around the tablet / Hearing the assigned sounds of the targets when caught / Looking under the tablet
Physical Design Parameters	Height: Plate assembly is vertically adjustable Angle of the plate: Parallel to the dogs' nose surface	Shape: Virtual targets are in the shape of a ball and a rat to be familiar for the dog
Features Of the Animal	Difference in height of snout across breeds Classification for concentration of cancer cells and selecting in an order of importance is too abstract for dogs. Honest signaling is used by linking this classification to dogs' natural behaviors (frequency and time spent while sniffing).	Personality traits showed themselves in the reactions of the dog participants, one being relaxed and the other is showing signs of nervousness and anxiety
Behavior Sense-Making	Quantitative analysis of sensor outcomes from the plates	Ethograms: Observed interactions with the tablet is compared with the ones in the preliminary ethogram created for dog-tablet play interactions Behavior that are not directed towards the table are part of the interaction as well and can be interpreted as motivational conflict due to not being able to catch the target
Type Of Participation	Training for prototypes - operant response Direct interaction for final product - stimulus response	Training: To "catch" virtual targets with positive reinforcement using verbal rewards and food rewards

Source	(Zeagler et al., 2014)	(Byrne, Zeagler, et al., 2018)
Study	System: Infrared touch sensor mounted glass with a LED flat screen behind it for projection of the targets Aim: Understanding affordances for touchscreen usability for dogs	System: First-contact tapping, Lift-off tapping Aim: Offering touchscreens at home for assistance dogs to operate in the case of emergencies as an alert tool
Type	Touchscreen Interface	Touchscreen Interface
Type Of Interaction	Passive: Wearing Visual: Seeing the collar before wearing Auditory: Hearing the clicking sound when owner is strapping it	Touching: Nose touching to the screen Auditory: Different frequency tones assigned to targets
Physical Design Parameters	Shape: Circle compared to irregular shapes to understand the intention of the dog better while selecting the target Target color: Yellow and blue used for differentiation	Target size Distance between targets Size of sliding paths Colors of the targets Location of the interface: Depends on the height of the dog
Features Of the Animal	Due to nose moisture and dog saliva staying on the screen and affecting the results, capacitive and ultrasonic screen cannot be used. Infrared touch surface is used. Temperament: During the trials, after performing a couple of unsuccessful trials, getting less patient with the system, and barking at it	Height difference across breeds Using sight to find virtual objects
Behavior Sense-Making	Recorded touchscreen interactions to measure the target distance, target time, target selection speed and location of selection	Recorded interactions
Type Of Participation	Training: Shaping Training: Backchaining	Training: Luring Training: Shaping Training: Backchaining

Source	(Logas et al., 2018)	(H Wirman, 2014)
Study	System: A slider on a touchscreen interface consisting of a handle and a track Aim: Exploring abilities of dogs in moving visual objects along a defined, distinctive path	System: Touchscreen protected by a glass and framed by a rigid structure fixed to a surface Aim: Providing enrichment for captive orangutans through species-specific and cross-species game design of moving objects on the screen, touching to disappear them and opening video clips
Type	Touchscreen Interface	Touchscreen Interface
Type Of Interaction	Touching: Selecting the handle and dragging it along the track	Touching: Apes use not only their fingers but also their palms and fists, sometimes stroking legs, feet, shoulders, genital parts Licking and biting the screen / Wiping the screen with the food in their hands
Physical Design Parameters	Shape: Shape of the track determines the complexity of the interaction	Input force: Apes are using significant force to touch the screen / Viewing position: Positioned either too close or too far / Viewing angle: An upside down angle, conforming to an upright-sitting angle while images are shown / Shape: Photographs and life footage are preferred compared to 2D graphics
Features Of the Animal	N/A	Posture while using the screen, not sitting upright as humans all the time Learning not to touch moving images (possibly from the usage of human designer) Not taking the instructions from the researcher and insisting on their own exploration
Behavior Sense-Making	Logging the touch events and trial data Hypothetical feedback scheme is built on color-based visual stimuli which is interpolating the color according to the progression of the slider. As alternative modification for these, tactile motors or sounds are suggested.	Observation for prototype testing
Type Of Participation	No dogs are participated to the design	Free-will Design researcher does not try to teach 'correct' way of using the system, but rather let the play dynamics show their effects to explore natural interaction

Source	(Mankoff et al., 2005)
Study	<p>System: Screen to show human companion in their workspace with other humans to the dog and a game system releasing a tennis ball when boredom is informed to human when pressure-sensed dog bed is activated by dog lying down on it</p> <p>Aim: Enabling interaction between dog and the human companion, both to inform home alone dog about its human companion to satisfy the pack awareness for dog and entertain the dog when it shows boredom by human-controlled remote ball play</p>
Type	Screen
Type Of Interaction	<p>Watching and listening screen and sounds coming from it</p> <p>Touch: Passive interaction of lying down on the dog bed</p> <p>Fetching the tennis balls released from the system</p>
Physical Design Parameters	Color: Dogs ability to detect colors blues and greens to greys and creams
Features Of the Animal	<p>Vision: Due to the overlapping wider view, less of the seen in close up is focused</p> <p>Hearing: Dogs hear higher-pitched sounds compared to humans at four times the distance of humans</p>
Behavior Sense-Making	Observation and video recording
Type Of Participation	Free-will

Source	(Ilyena Hirskyj-Douglas et al., 2014)	(I. Hirskyj-Douglas et al., 2017)
Study	System: Television screen Aim: Exploring the possibility of dogs having meaningful interactions with TV screen by face tracking	System: Three television screens and twelve videos Aim: By offering different screens and media content, understanding whether dogs choose to watch TV and if so, what their preferences are
Type	Screen	Screen
Type Of Interaction	Visual: Watching TV	Visual: Watching TV
Physical Design Parameters	N/A	Screen positioning at the dogs' eye level
Features Of the Animal	Color of the fur: No color difference for dogs with dark fur with their eyes, main tracked object. Related algorithm works for dogs with lighter fur, hence dog-specific Dogs' skeletal structure: System is to be developed for recognizing the joint movements	Sound of the videos were not loud due to dogs' hearing capabilities Blank screen in between videos not to overwhelm the participant
Behavior Sense-Making	Quantitative analysis of gaze	Video recording and quantitative analysis based on the observations
Type Of Participation	For eye tracking, dogs have to stay in their location. Static training is necessary for that. Free will in this study.	Free will, no training and no rewards

Source	(Ilyena Hirskyj-Douglas & Read, 2018)(Kim, Choi, Kim, Kim, & Cho, 2009)
Study	System: A monitor, a webcam, two speakers, and an Arduino tracking/sensing device showing selected media clips and accompanying sounds Aim: By creating an automated screen device controlled by body tracking, to explore the interaction modalities between television and dog, giving control to a dog to activate the screen,
Type	Screen
Type Of Interaction	Visual: Watching TV Audio: Hearing the sounds from 39 media clips of different dogs in different situations
Physical Design Parameters	Installation location: At head height of the dog
Features Of the Animal	System activation is calibrated according to the height of the dog's chest. This allows dog to perform one of its natural behaviors, without continually activating the system. Entire process took place in the home of the dog participant, to provide a relax environment.
Behavior Sense-Making	Recording of the activation. In addition to this direct data from dog-end user, open-ended questions for the human companions of dogs used as supporting data.
Type Of Participation	Free-will. To allow the natural behavior of the dogs, infra-red range detectors are selected. Other options of posture tracking or head positioning required system to be trained for images, and directly affect the dog during the creation of system training catalog.

Source	(Westerlaken & Gualeni, 2016)
Study	<p>System: 1. Sphero: A Bluetooth-controllable ball with an addition of dog treat as puzzle inside LEGO bricks, on top of the ball. 2. An open-ended toy with multiple compartments, having a sound emitting controller inside and objects having specific smells in the compartments</p> <p>Aim: Creating artefacts that are inviting playfulness and developing to the artefact base on the playful preferences of dog participants</p>
Type	Smart Toys
Type Of Interaction	<p>1. Touching: Sending it to different directions, trying to take out the treat inside the covers and later on inside the puzzle with their mouths or paws, Fetching: Running after the ball Smell and Taste: After the addition of flavor to the ball inside the covers, they have sniffed it and tried to taste it.: 2. Sniffing, Biting, Moving around</p>
Physical Design Parameters	<p>1. Material: Hard plastic material of the ball made it hard for dogs to grab it by mouth and the designer covered it with a soft texture in return of this feedback. Size: First prototype was too big for grabbing by the mouth and hence got smaller. Dog barked at the bigger toy, which is interpreted by the designer (and human companion at the same time) as a recurring behavior that it does towards the objects it would like to play but too big for it to play. 2. Material: Soft cover on the outside</p>
Features Of the Animal	<p>1. Two participants of the study showed really different reactions revealing their individual personalities. During the iterative design process of prototypes from lo-fi to hi-fi, one of the participants developed an understanding of how the puzzle integrated to the artefact works. 2. One reacted positively to loud noises, and the other to low-volume sounds. Designer personalized the sounds emitted from the toy, by adding RFID (radio-frequency identification) tags to their collars and different sounds activated by respective RFID tag.</p>
Behavior Sense-Making	<p>Ethnography: Observation of their behavior and taking notes. Approaching to the ball or staying and observing in a safe and high position. Video recording</p>
Type Of Participation	<p>Free-will. Dogs were in control of the artefact. Picking it up with their mouth or paws, moving it as they like, taking the treat out of it and hence finishing the play session. When on dog showed signs of uneasiness like approaching the artefact slowly and carefully, moving away when it moves suddenly, designer interpret it as the interaction not being playful anymore and continued the design process with the other dog participant.</p>

Source	(Pons et al., 2017)
Study	<p>System: 1. Projecting digital mice onto the surface 2. Sphero: A Bluetooth-controllable ball, glowing, colors and brightness are adjustable 3. Parrot Jumping Sumo: A wi-fi controllable toy with wheels, a cat toy attached to it</p> <p>Aim: Understanding interactions and preferences of cats towards technology by developing a personalized, autonomously adaptive toy offering multiple interaction modalities</p>
Type	Smart Toys
Type Of Interaction	<p>Sight: Visual digital stimuli Touch: Trying to catch the tangible artifact or digital image.</p>
Physical Design Parameters	<p>Size: Comfortable with smaller robot to resemble a real prey. Shape: Cartoonish mice</p>
Features Of the Animal	<p>Novelty factor: When system detects that cat's interest is diminishing, controlling system changes the behavior of the artifact. Frustration: Visual digital stimuli should be supported with other kind of stimuli and/or rewards, otherwise not being able to catch the light might trigger frustration for the animal.</p>
Behavior Sense-Making	Depth-based tracking system is used to classify cat's body parts and body postures to analyze play dynamics.
Type Of Participation	Free-will. Cats were free to explore the room and leave the activity as they wish.

Source	(Byrne, Zuerndorfer, et al., 2018)
Study	System: A silicone ball sensor and a silicone tug sensor Aim: Quantifying temperament of dogs to assess puppy suitability for service dog training
Type	Smart Toys
Type Of Interaction	Fetching Tugging Biting
Physical Design Parameters	Material: Silicone rubber for ball, safe for biting and chewing on, suitable for washing in between usages Material: Silicone tube for tug sensor with a faux fur cover Size: Limited by dimensions of SD card
Features Of the Animal	Dog's saliva, as an inevitable anatomic output, has an impact on the working of mechanisms. To prevent slippage between components or any leakage to the electronics, system should be full contained to be protected from saliva. Solitary object play Social play
Behavior Sense-Making	Quantified measurements obtained from the sensors such as interaction time, number of bites, bite/tug strength, bite/tug duration, bite frequency. Video recording.
Type Of Participation	Training. Participants, as working dogs, had already undergone or were still undergoing advanced training.

B. Interview Questions and Mindmap for Animal Experts

[Amaç: Köpekler için refah tanımı yapmak, refah durumuna etkisi olan unsurları anlamak]

1. 'Animal welfare' için Türkçe kullanım karşılığı nedir?
2. Bir köpeğin welfare durumunu nasıl tanımlayabiliriz?
 - Sahiplenildikten sonra evde yaşayan bir köpekle, arama-kurtarma ya da rehber köpeği olarak çalışan bir köpek arasında, welfare açısından herhangi bir farklılık gözlemlenebilir mi?
 - Köpeğin hangi yaşta sahiplenildiği welfare'ini sağlama adına neleri değiştirir?

[Amaç: Köpeklerin sahiplenilme öncesindeki geçmişlerinin davranış özelliklerine etkisini ve geçmişe bağlı olası travmalarını anlamak]

3. Sahiplenilen köpeklerin geçmişlerini düşünürsek eğer; sokaktan, barınaktan ya da bir başka evden sahiplenme senaryolarında köpeklerin davranış bozuklukları açısından belirginleşen tipik özellikler var mı?
 - Sokakta yaşayan köpekler neler deneyimliyorlar ve bu deneyimler davranış özelliklerini nasıl şekillendirir?
 - Barınakta yaşayan köpekler neler deneyimliyorlar ve bu deneyimler davranış özelliklerini nasıl şekillendirir?
 - Ev değiştiren bir köpeği düşündüğümüzde, ne gibi temel travmalar yaşaması ihtimal dahilindedir?

[Amaç: Köpeklerin sahiplenilmesine etken unsurların anlaşılması]

4. Sizce insanlar ne gibi motivasyonlarla köpek sahiplenme kararı verirler?

[Amaç: Köpeklerin sahiplenme sonrasında ev ortamına uyumunu, kendisi de dahil olmak üzere farklı aktörlere karşı davranışlarını anlamak]

5. Sahiplenme süreci genel olarak nasıl ilerler?

6. Yeni sahiplenilen bir köpek için ev kavramı nasıl oluşur?
- Köpeğin eve girişi sonrasında kendi kendine ya da sahiplenilen kişiye karşı ne gibi davranışlarda bulunmasını beklersiniz?
 - Bu senaryoda eve sırasıyla bir kedi, bir çocuk ve başka bir köpek daha eklersek eğer, sahiplenilen köpeğin nasıl davranışlar göstermesini beklersiniz?

[Amaç: Köpeklerin davranış bozukluklarını anlamak ve böyle durumlarda iyileştirme adına nasıl iletişimde bulunulacağını öğrenmek]

7. Köpeğin geçmişinden gelen travmalar hangi davranışlarla kendini belli eder?
- Travma belirtileri gösteren köpeklere nasıl yaklaşılmalıdır?
 - Hangi travma çeşitlerine, ne gibi araç ya da metotlarla müdahale edilebilir?

[Amaç: Köpeklerin davranışlarını yorumlayabilmeyi öğrenmek]

8. Köpeklerin kendi başlarına yaptıkları davranışları, diğer hayvanlara ya da insanlara karşı olan davranışlarını nasıl okuyabiliriz? Buna dair yöntemler var mı?

[Amaç: Köpekler ve teknoloji arasındaki ilişkinin davranış bilimci uzmanlar tarafından nasıl algılandığını anlamak]

9. ‘Köpeklerin teknoloji ile etkileşimi’ dediğimizde aklınıza ne geliyor?
- İnsanların ve köpeklerin teknolojiyle etkileşiminde temel farklar sizce nelerdir?

(Mindmap çalışmalarını tamamladıktan sonra)

10. Köpeklerin sahiplenildiği ev ortamına uyumları için nasıl bir ürünle etkileşime girmelerini, nelerden uzak durmalarını önerebilirsiniz?
11. Bu çalışma için eklemek istediğiniz, dikkat edilmesi gerektiğini düşündüğünüz noktalar var mı?

MINDMAP

[Amaç: Köpeklerin etkileşim tercihlerini, davranışlarını, uyaranlara karşı gösterdikleri tepkileri yorumlayabilmeyi öğrenmek]

Uyaran Tablosu

İnsanlar teknolojiyle etkileşimlerinde input ve feedback vermek için genel olarak ellerini veya sesli komutları kullanıyorlar. Ev ortamında köpeklerin etrafında yer alabilecek canlı ve cansız tüm uyaranları düşünelim. Cansızlara örnek olarak ev mobilyaları gibi teknolojik olmayan ve beyaz eşya, televizyon vb. teknolojik olan cihazları düşünebiliriz.

- Aşağıdaki uyaran kategorilerini düşünürsek köpekler nelere olumlu tepki verip, etkileşime girmeyi seçerler ve nelere olumsuz tepki vererek, etkileşimden kaçınırlar?

Vücut Haritası

- Köpekler hangi modalitelerle etkileşim kurarlar? Etkileşim için hangi uzuvlarını kullanırlar? [Pati, burun, yalamak, koklamak, havlamak vb.]
- Köpeklerin fiziksel açıdan hassas oldukları (hoşlanmadıkları) ve hoşlandıkları vücut bölgeleri nelerdir?
- Köpeklerin vücut hareketlerini, hissettikleri durumlarla bağdaştıran bu görselleri doğrulukları ve geçerlilikleri açısından değerlendirirseniz neler söyleyebilirsiniz?

Perceptual Map

	Vision	Sound	Touch	Smell	Taste	Kinesthetics	Other
+							
-							

Intensity of light
Color
Shape

Music
Lightning
Voice of the owner

Texture
Hardness
Temperature

Being yanked away

Figure 18 - Perceptual Map for Expert Interview

Body Map

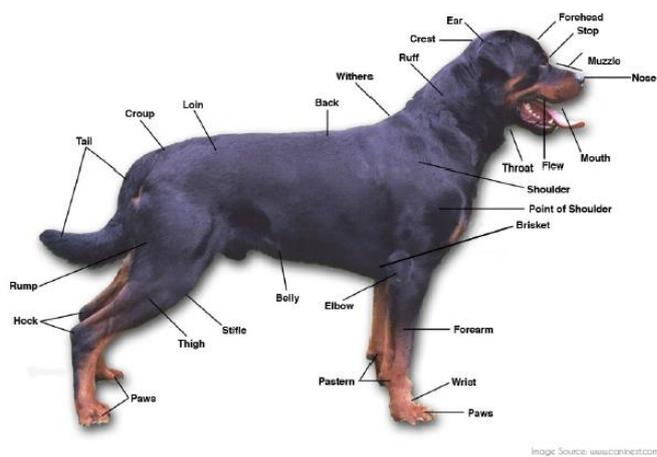


Figure 19 - Body Map for Expert Interview

Behavioral Map

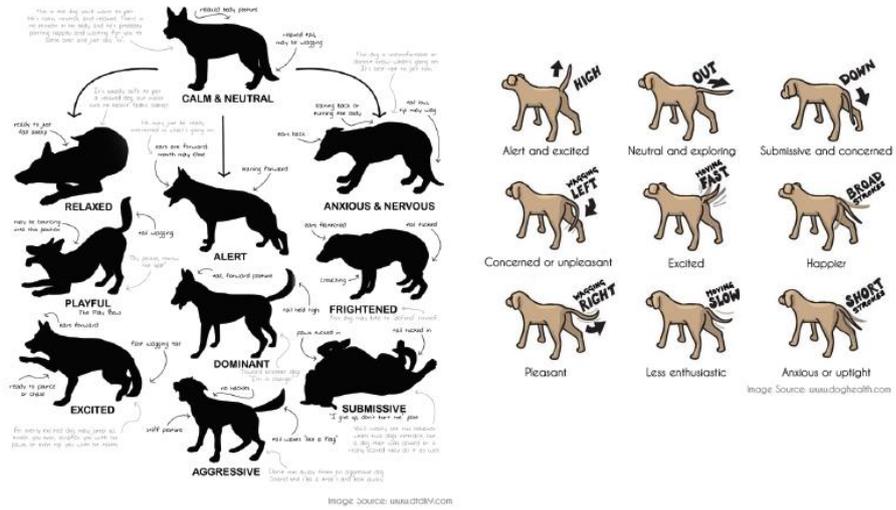


Figure 20 - Behavioral Map for Expert Interview

C. Interview Questions and Mindmap for Dog Families

[Amaç: Sahiplenilen köpeğin geçmişine ve güncel durumuna dair bilgi almak]

1. Kaç köpeğiniz var ve isimleri neler?
2. Köpeğinizi ne zaman sahiplendiniz?
3. Sahiplendiğinizde kaç yaşındaydı?
4. Köpeğinizin cinsiyeti nedir?
5. Köpeğinizin cinsini/türünü biliyor musunuz?
6. Nereden sahiplendiniz?
7. Sahiplenme kararını nasıl aldınız?
8. Köpeğinizin sahiplenme öncesindeki hayatına dair bir bilginiz var mı?

[Amaç: Sahiplenen kişinin köpek sahiplenme ve yetiştirme konusundaki geçmişini öğrenmek]

9. Daha öncesinde hiç köpeğiniz oldu mu? Onun eğitimini siz mi yaptınız?

[Amaç: Sahiplenme sürecindeki deneyimleri anlamak]

10. Sahiplenme sürecini ve o süreçte yaşadıklarınızı anlatabilir misiniz?
11. Köpeğiniz eve gelmeden önce herhangi bir eğitimden geçti mi?

[Amaç: Sahiplenilen köpeğin eve getirildikten sonraki davranışlarını anlamak]

12. Köpeğinizle birlikte eve geldiğiniz ilk anı hatırlıyor musunuz, neler oldu anlatabilir misiniz?
13. Ev içerisinde davranış bozukluğu olarak adlandırabileceğiniz herhangi bir problemle karşılaştınız mı?
14. Bu problemlerin çözümünde nelere başvurduunuz? Kullandığımız ürünler var mıydı? Ne gibi müdahalelerde bulundunuz?

[Amaç: Sahiplenilen köpeğin ev ortamındaki aktörlerle etkileşimini anlamak]

15. Evinizde başka bir hayvan var mı? Var ise ona karşı davranışı nasıl?

16. Evde sizinle ve köpeğinizle birlikte yaşayan başka birisi var mı? Var ise onunla nasıl bir ilişkisi var?
17. Köpeğinizle günlük rutininizi anlatabilir misiniz?
18. Ev içerisinde hoşuna giden/gitmeyen yerler neler? Fotoğraf çekilebilir. Neden oraları sevdiğini düşünüyorsunuz?
19. Köpeğinizi neyle besliyorsunuz?
20. Sizin davranışlarınızdan olumlu/olumsuz tepki verdiği tipik örnekler nelerdir?

[Amaç: Köpekler ve teknoloji arasındaki ilişkinin köpek sahiplenenler tarafından nasıl algılandığını anlamak]

21. ‘Köpek teknoloji etkileşimi’ dediğimizde aklınıza ne geliyor? Köpeğiniz üzerinden örnek verebilir misiniz?
22. Ev ortamında neyle oynuyor, neyi tercih ediyor?

(Mindmap çalışmalarını tamamladıktan sonra)

[Amaç: Köpek ailelerinin aktarmak istedikleri deneyimleri anlamak]

23. Köpek sahiplenmeyi düşünen insanlara neler önerirsiniz? Ne yapmalarını, ne yapmamalarını tavsiye edersiniz?
24. Nasıl bir ürün olsaydı işinize yarardı ilk süreçte?

MINDMAP

[Amaç: Köpeklerin etkileşim tercihlerini, davranışlarını, uyaranlara karşı gösterdikleri tepkileri yorumlayabilmeyi öğrenmek]

Uyaran Tablosu

Eviniz içerisinde köpeğinizin etrafındaki ortamı canlandırın aklınızda. Köpeğinizde herhangi bir tepki yaratan unsurları uyaran olarak tanımlayabiliriz. Bu işitsel, görsel, koku bazlı vb. olabilir. Ev mobilyalarımız gibi teknolojik olmayan nesnelere; beyaz eşya, televizyon gibi teknolojik nesnelere tüm uyaranları düşünün. Buna göre

aşağıdaki uyaran kategorilerine bakarsak eğer köpeğiniz nelere olumlu tepki verip, etkileşime girmeyi seçer ve nelere olumsuz tepki vererek, etkileşimden kaçınır?

Vücut Haritası

- Köpeğinizle günlük iletişiminizi ve oynadığınız oyunları düşündüğünüzde, hoşunuza giden davranışlarına nasıl tepki verirsiniz? Köpeğinizden karşılığında nasıl bir tepki alırsınız? Bu etkileşim sırasında temas ettiğiniz bölgeleri harita üzerinden göstererek anlatabilir misiniz? [Mavi renk ile işaretlenecek.]
- Köpeğiniz hoşunuza gitmeyen bir davranışta bulunduğu anda ona nasıl bir tepki verirsiniz? Bunun karşılığında köpeğinizden nasıl bir tepki alırsınız? Aynı şekilde temas ettiğiniz bölgeler varsa eğer, harita üzerinden göstererek anlatabilir misiniz? [Kırmızı renk ile işaretlenecek.]
- Köpeğinizin etkileşime girdiği canlı veya cansız, tüm kişi veya nesnelere düşündüğünüzde, köpeğiniz vücudunun hangi bölgeleriyle bu etkileşimi başlatır? Neresiyle keşfetme, inceleme gibi davranışları gerçekleştirir? [Yeşil renk ile işaretlenecek.]

Perceptual Map

	Vision	Sound	Touch	Smell	Taste	Kinesthetics	Other
+							
-							

Intensity of light
Color
Shape

Music
Lightning
Voice of the owner

Texture
Hardness
Temperature

Being yanked away

Figure 21 - Perceptual Map for Family Interview

Body Map

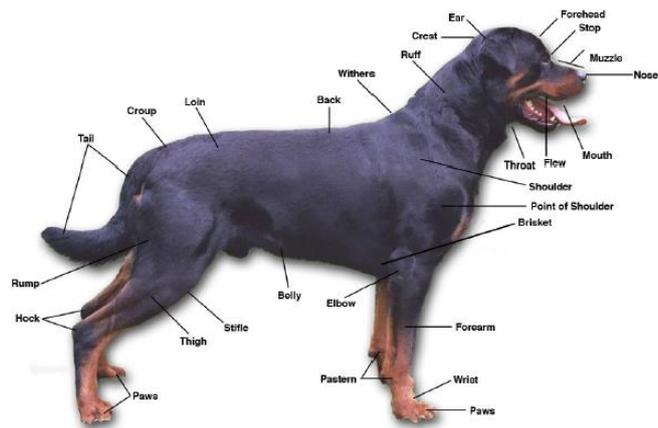


Image Source: www.canineart.com

Figure 22 - Body Map for Family Interview