TECHNOLOGY FOR BETTER ANIMAL CARE: IDENTIFYING THE DIMENSIONS FOR INCREASING THE CARETAKERS' AWARENESS THROUGH DOG ACTIVITY MONITORING SYSTEMS

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ABSTRACT

TECHNOLOGY FOR BETTER ANIMAL CARE: IDENTIFYING THE DIMENSIONS FOR INCREASING THE CARETAKERS' AWARENESS THROUGH DOG ACTIVITY MONITORING SYSTEMS

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Wearable technologies for animals are becoming increasingly popular, promising to enhance the lives of both companion animals and humans through smart experiences. In the last ten years, wearable technologies for animals have become increasingly popular, and activity monitoring systems are one of the most commonly used types of technology. However, there is a limited amount of research on dog activity monitoring systems and their impact on the lives of caretakers and their awareness, despite the growing number of studies on wearable technologies for humans. This thesis aims to fill this gap by conducting a longitudinal study with 30 participants, exploring the dimensions of interaction with dog activity monitoring systems, caretaker personas related to the use of these systems, and their potential to contribute to the caregiving of dogs. The study involves participants using a specific dog activity monitoring device for six weeks, along with in-depth interviews, experience sampling method, and complementary questionnaires. The findings are used to develop the DAMS-mediated stage-based awareness model that explains how dog activity systems can mediate the human-dog relationship and support the caregiving of dogs.

Keywords: Animal-computer interaction, dog, animal welfare, dog activity monitoring systems

ÖZ

HAYVANLARA DAHA İYİ BAKMAK İÇİN TEKNOLOJİ: KÖPEK AKTİVİTE TAKİP SİSTEMLERİ İLE İNSAN FARKINDALIĞINI ARTIRMA BOYUTLARININ BELİRLENMESİ

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Hayvanlar için giyilebilir teknolojiler giderek daha popüler hale gelmekte ve sundukları akıllı deneyimler yoluyla hem günlük hayatı paylaştığımız evcil hayvanların hem de insanların yaşamlarını iyileştirmeyi vaat etmektedirler. Son yıllarda hem ürün hem de kullanıcı sayısı gittikçe artan ve son kullanıcıya yönelik en yaygın giyilebilir teknolojilerden olan köpeklere yönelik aktivite takip teknolojileri, evcil hayvan ürünleri endüstrisinde de yerini alarak yaygınlık kazanmaya başlamıştır. Bununla birlikte, insanlar için giyilebilir teknolojiler üzerine artan sayıda çalışma olmasına rağmen, köpek aktivite takip sistemleri ve bu teknolojilerin hayvan bakım kalitesi, hayvan sahiplerinin yaşam biçimleri ve farkındalıkları üzerindeki etkileri hakkında sınırlı sayıda araştırma bulunmaktadır. Bu tez, köpek aktivite takip sistemleri ile etkileşimin boyutlarını, bu sistemlerin kullanımıyla ilgili hayvan sahibi personaları ve bu teknolojilerin köpek bakım kalitesine katkı sağlamak bakımından potansiyellerini, 30 katılımcının yer aldığı uzun dönemli bir alan araştırması ile inceleyerek bu boşluğu doldurmayı amaçlamaktadır. Çalışma, katılımcıların altı hafta boyunca belirli bir köpek aktivite takip cihazını kullanmasının yanı sıra derinlemesine görüşmeler, deneyim örnekleme yöntemi ve tamamlayıcı anketleri içermektedir. Bulgular, köpek aktivite takip

sistemlerinin insan-köpek ilişkisine nasıl aracılık edebileceğini ve köpek bakımını nasıl destekleyebileceğini açıklayarak, bu teknolojilerin tasarımında yol gösterici teorik bir çerçeve oluşturmak üzere, DAMS-aracılı aşama temelli farkındalık modelini geliştirmek için kullanılmıştır.

Anahtar Kelimeler: Hayvan-bilgisayar etkileşimi, köpek, hayvan iyi oluşu, köpek aktivite takip sistemleri

To my father

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TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

TABLES

LIST OF FIGURES

FIGURES

LIST OF ABBREVIATIONS

ABBREVIATIONS

ACI	Animal-Computer Interaction
ANT	Actor Network Theory
C-BARQ	Canine Behavioral Assessment and Research Questionnaire
DRM	Day Reconstruction Method
HCI	Human-Computer Interaction
DAMS	Dog Activity Monitoring System
ESM	Experience Sampling Method
GPS	Global Positioning System
IIS	Interspecies Information System
iOS	iPhone Operating System
MEAU	Method for Evaluating Animal Usability
MDORS	Monash Dog-Owner Relationship Scale
MTHD	More Than Human Design
PTSD	Post Traumatic Stress Disorder
SAR	Search and Rescue
TTM	Transtheoretical Model of Change
UI	User Interface
UX	User Experience

CHAPTER 1

INTRODUCTION

1.1 Problem Background

Interactive technologies have long been in the daily lives of both humans and animals. They increasingly become more embedded in every aspect of life, changing the way how human and non-human animals live. Today, animals come into contact with technologized environments, systems, and products on a day-to-day basis. While there have been interactive technologies for non-human animals like robotic milking systems and biotelemetry devices for quite some time, they have typically been designed without taking into consideration animal factors such as their cognitive, physiological, and behavioral characteristics, as well as their needs and preferences, as noted by Mancini (2011). Nevertheless, the lack of an animal-centered approach during the design and development of such technologies is likely to affect animals' welfare adversely as their capabilities, needs, and experiences are often not considered. While ubiquitous computing technologies continue to become an integral part of human life increasingly, concerns over the underrepresentation of animals and the prevalence of anthropocentric approaches in the design of animal technologies have increased (Mancini, Lawson & Juhlin, 2017).

Along with the increasing concerns over this issue, Animal Computer Interaction (ACI) has emerged as a research area expanding the boundaries of a relatively mature field, Human-Computer Interaction (HCI), to include non-human animals as users for the design and development of technology (Mancini, Juhlin, Cheock, van der Linden & Lawson, 2014). The development of ACI studies is essential, interactive technologies have the potential to ensure animals' welfare in an economically sustainable way (Jukan, Bruin & Amla, 1994). These technologies can improve animals' well-being by providing ways to fulfill their needs, support them in their assigned functions, and promote the relationship between humans and animals by enabling communication through various means (Mancini, 2011).

Within the ACI field, dogs hold a unique position as they are firmly ensconced in human society as companions. Dogs are the oldest domesticated animal, and they have been living with humans for approximately 30,000 years (Gompper, 2014). Dogs have been part of humans' daily lives and our evolutionary path. They possess a unique ability to comprehend human social and gestural cues, which sets them apart from all other non-human mammals, likely due to their co-evolution with humans (Hare & Tomasello, 2005). Moreover, due to both their social proximity to humans and their unique capabilities, they are assigned a variety of roles in human society, including search and rescue (SAR), bomb and drug detection, assistance, hearing assistance, guide dogs, medical alert, PTSD/emotional support dogs, and pets (companion animals) (Freil et al., 2017). Especially in homes, dogs find themselves in increasingly technologized environments. As their co-evolution with humans continues, it is for sure that they will be more engaged in interactive technologies in the upcoming years. Considering that HCI has provided multiple benefits for humans working with technology by increasing their efficiency, effectiveness, and productivity; similarly, the development of ACI can offer similar benefits to dogs interacting with technology (Freil et al., 2017). Besides, dogs' special social skills make them suitable candidates for ACI studies, probably more than any other species, because they are easier to work with.

Dogs are the most widely kept pet animal globally, with increasing adoption rates and spending on related products and services (Grand View Research, 2019). However, research suggests that the inadequate knowledge of dog owners about their pets' health and behavior can have negative impacts on dog welfare. As an example, according to a survey conducted by Rohlf and colleagues (2010), even dog owners who are considered to be committed fail to follow responsible dog ownership practices, including confinement, registration, microchipping, desexing, participation in formal obedience training, and regular socialization practices. The survey also found that certain aspects of dog welfare have worsened instead of improved in recent years. As cited in Philpotts, Dillon, and Rooney (2019), the top five welfare concerns related to caretaker practices are as follows;

- pedigree or poor breeding practices (Rooney & Sargan, 2010; Packer, Murphy and Farnworth, 2017),
- obesity (Degeling, Kerridge and Rock, 2013; Luno et al., 2018),
- dog behavior and training (Blackwell, Bradshaw, and Casey, 2013; Todd, 2018),
- dog purchasing and relinquishing behaviors (PDSA, 2017; Packer, Murphy and Farnworth, 2017; Summerton, 2015; Sandoe et al., 2017),
- dog companionship or being left alone for extended periods (RSPCA, 2018; PDSA, 2017; Norling & Keeling, 2010).

Although caretakers have access to a wealth of information through various sources such as online resources, volunteer organizations, and veterinarians, it is surprising that dog welfare continues to decline. The ways in which people care for their dogs have changed over the years due to changes in human lifestyles. McGreevy and Bennett (2010) explain that this shift is reflected in what humans currently expect from their pets and our ability to meet their needs. For instance, caretakers now spend a lot of money on grooming and dog clothing with the goal of making their pets happier. Over the past few years, the prevalence of obesity and obesity-related health issues in dogs has increased significantly, leading to a decline in their quality of life (Degeling, Kerridge, and Rock, 2013; Luno et al., 2018; Greenebaum, 2010). Moreover, research indicates that there is a lack of understanding among dog caretakers about certain aspects of their dogs' behavior, such as trainability (Mirko, Doka & Miklosi, 2013), play signals (Tami & Gallagher, 2009), emotional arousal (Kerswell, Butler, Bennett & Hemsworth, 2010), and acute stress (Mariti et al., 2012). Furthermore, a thorough survey conducted on dog owners has revealed that many of them overestimate their dogs' cognitive abilities (Howell, Toukhsati, Conduit & Bennett, 2013).

Moreover, caretakers' attribution of anthropomorphic behaviors to dogs, such as associating certain dog behaviors with their feeling and expression of guilt, without any sound scientific evidence, might lead to unrealistic expectations from companion dogs, which in turn might bring about potential relationship breakdowns (Horowitz, 2009). Additionally, they often fail to recognize severe signs of common diseases in older dogs, indicating a lack of understanding of critical issues related to dog health and behavior (Davies, 2011). While caretakers may not intend to cause any harm or suffering to their dogs, this lack of awareness can result in various problems, including dysfunctional human-dog relationships, behavioral issues in dogs, and reduced quality of life for both parties (Salgırlı et al., 2012).

Research indicates that human behavior and the quality of care provided to dogs can impact their emotional and physical health. For example, human behaviors such as positive reinforcement (Deldalle & Gaunetand, 2014), affiliation (Horvath, Doka & Miklosi, 2008), human attention (Schwab & Huber, 2006), and safety (Gacsi et al., 2013) are known to contribute to positive emotional states in dogs, which are likely to produce positive behavioral outputs lead to positive emotional states in dogs, which can result in positive behavioral outcomes. Dogs also demonstrate attachment behaviors toward humans that resemble the bond observed between infants and their caregivers (Serpell, 1996), as defined in Bowlby's attachment theory (1958). This similarity is highlighted by their tendency to engage in proximity-seeking behaviors when the attachment figure is absent, which serves as a coping mechanism for dealing with stress, as evidenced by studies such as Schoeberl et al. (2012). Relatedly, Dogs who are considered by their caretakers to be "meaningful companions" or "social partners" tend to have lower levels of cortisol in their saliva, which is an indicator of reduced stress (Schoeberl et al., 2012, p.199). Likewise, clinical studies demonstrated that interacting with dogs provides several psychological health benefits for humans (Barker & Wolen, 2008; Schneider et al., 2014). Based on this information, it can be concluded that human attitude is an essential factor in moderating the human-dog relationship. Therefore, promoting positive human behavior can enhance the relationship between humans and dogs, resulting in mutual advantages.

Despite current access to the vast amount of data sources online, finding the most accurate information on animal health and well-being can be challenging for caretakers. Especially on welfare-related critical issues, the data must be appropriately presented to the caretakers to ensure proper guidance (Davies, 2011). It is also of particular significance that the provided information is accurate, informative, and specific to the individual and species to avoid unwanted consequences. In this sense, the technologies that utilize smart sensors to monitor the behavior and health of animals appear to be a promising way for informing dog owners about their companion animals' behavior and health.

As the Internet of Things (IoT) becomes more widespread, wearable technologies for animals are also becoming more popular. Such wearables can enhance the lives of both humans and animals by offering smart features and experiences. Wearable technologies are one of the most commonly used types of IoT devices available. These devices provide caretakers essential health-related data about their companion animals, such as daily activity and sleep levels, energy expenditure, and rest time. The pet wearables market estimated will grow at a 14.3% CAGR until 2030 (Grand View Research, 2023). These products on the market are primarily targeted toward dogs, most probably because the dog segment accounted for the biggest share of the pet products market by %39 in 2021 and is expected to expand in the near future (Grand View Research Report, 2022). It is evident that the quantity of wearable gadgets designed for dogs and their human users has increased in the past decade and is predicted to continue to grow in the upcoming years.

However, although there has been a significant amount of research on wearable technologies for humans, there is limited number of studies examining the effects of pet activity monitoring devices on the lifestyles of caregivers and the well-being of animals. As an example of the studies on wearables for animals, Alcaidinho et al. (2015) examined whether using dog activity monitors can reduce the return rate of newly adopted dogs from a shelter. Twelve participants were provided information about their newly adopted dogs' daily activity and rest levels via a commercially available dog activity tracker attached to dogs’ collars and synched with the mobile application for eight weeks. The study involved conducting surveys with adopters, at one-week and one-month intervals post-adoption, to investigate their experience of the technology and its impact on their relationship with their dogs. The study showed that providing health and activity-related data to adopters through a mobile application has resulted in a decrease in dogs’ re-relinquishment rates. The findings also showed a reported change in both dogs’ and adopters’ habits regarding increased activity levels and time spent together based on the information provided via the trackers. Thus, the results supported the hypothesis that framing dog monitoring data leads to behavior change in humans, similar to how framing personal tracking information affects people’s behavior and health.

In another study, it was found that even a simple GPS-enabled collar can improve human-dog relationships by opening up new forms of interaction (Weilenmann & Juhlin, 2011). Also, Vaataja et al. (2018) investigated the caretakers’ motivation to use dog activity monitoring devices. In the study, researchers conducted semi-structured interviews with seven Finnish dog activity tracker users combined with an international online survey. The semi-structured interviews aimed to identify how dog caretakers use dog activity monitors in everyday life, their motivations, and goals to use such devices, their user experiences, and the overall impact of device use on lifestyles. The findings and insights gained through the interviews were confirmed and supported by an international online survey. The study revealed that these devices were primarily utilized to monitor dogs’ health, behavior, and learning-related issues and balance daily activity levels and rest. The insights gained via the device served as a motivational factor for behavior change in caretakers to better respond to dogs’ needs. Zamansky et al. (2019), on the other hand, investigated users’ perceptions of dog activity tracker use and their experiences with these devices. In the study, eighty-one users of a particular dog activity tracker were recruited through social media and participated in a questionnaire. The study revealed that the device use resulted in an improvement in the quality of caregiving and increased awareness of caretakers’ responsibility for their dogs’ well-being. Moreover, these devices interestingly led to an increase in caretakers’ own activity levels and encouraged them to be more active together with their companion dogs during the day.

As can be seen, there are few qualitative studies that examine dog activity monitoring devices from a variety of perspectives. However, these studies have limitations as they do not thoroughly examine how dog technologies affect human behavior change. Although there are a few longitudinal studies (Alcaidinho et al., 2015; Zamansky et al., 2019), and some use a large sample (Zamansky et al., 2019), they do not examine how caretakers interpret dog tracking data and do not provide an in-depth understanding of data use of caretakers. Current research mainly concentrates on how dog monitoring technologies influence the relationship between humans and their dogs. Thus, how these technologies affect human behavior, how caretakers make sense of dog tracking data, and their impact on the quality of care is not studied as holistically as they are with humans.

In recent years, computer technologies have become more ubiquitous, and they have had a significant impact on human behavior. The relationship between technology and human behavior is symbiotic: technology affects human behavior, while human behavior affects the usage of technology (Slob & Verbeek, 2006). While the original purpose of computer technology was not to promote behavior change, in recent years, researchers have become interested in using these technologies to promote positive changes in behavior. This area of study is known as persuasive technology, which refers to interactive computing systems designed to modify people's attitudes, behaviors, or both (Fogg, 2003).

To better understand technology's persuasive potential, it would be helpful to mention the different roles that computer technologies play in human life.

On the functional triad framework, Fogg (2003) proposes that computing technologies have three essential functions from the users' perspective: tools, mediums, and social actors. In their role as tools, computer technologies aim to equip users with new capabilities, allowing them to do activities more easily and effectively. Computer technologies as tools can influence people's attitudes or behaviors in specific ways, such as by making the predetermined goals easier to achieve, guiding people through a process or experience, or performing calculations or measurements that motivate them. Computer technologies also function as mediums. These technologies have the ability to influence people's attitudes and behaviors by simulating experiences and enabling them to explore cause-and-effect relationships within those experiences. As social actors, computer technologies can reward people with positive feedback, model a target behavior or attitude, and provide social support to shape their behavior or attitudes. According to Fogg (2003), the information and feedback provided via interactive technologies are essential motivators for people to perform a behavior.

One example of persuasive technologies is personal health informatics systems. These systems allow individuals to modify their behavior by monitoring themselves and analyzing data, all with the goal of reaching a specific target. By collecting and examining data, these systems help users attain their objectives by presenting the data clearly and providing feedback when necessary (Fogg, 2003). Along with providing self-monitoring data, persuasive technologies utilize different strategies to encourage behavior change in individuals. Fogg (2003) describes seven types of behavior change techniques included in persuasive technologies: tunneling, tailoring, suggestion, self-monitoring, surveillance, and conditioning. Proper use of persuasive technologies has the potential to enhance people's awareness and motivation to perform desired behaviors. Previous studies have explored wearable fitness trackers for humans, which are a form of health informatics system, and have found that providing personal health-related insights by such devices can result in long-term behavior change in users (Choe, Lee, Munson, Pratt & Kientz, 2013). Another study examining the effects of using a fitness tracker on people's activity levels revealed that the device use resulted in a significant increase in participants' activity levels (Cadmus-Bertram et al., 2015). Moreover, further studies indicate that activity monitoring devices help users gain a more comprehensive understanding of their behaviors and activities within the context of the data provided by these devices (Fritz, Murphy & Zimmermann, 2014).

Along with technology's persuasive role, it is also crucial to consider how individuals change their behavior. The Transtheoretical Model (Figure 1.1), developed by Prochaska and Velicer (1997), The Transtheoretical Model, developed by Prochaska and Velicer in 1997, outlines five stages: pre-contemplation, contemplation, preparation, action, and maintenance. These stages are called the stages of change. According to Prochaska and Velicer (1997), these stages are referred to as the stages of change, and the primary strategy for promoting positive behavior change is to create awareness related to the issues associated with current behavior to move from the pre-contemplation to the contemplation stage. If people are not aware of their problematic behaviors or the need for a behavior change, it is unlikely that any change will occur, whether it is adapting current behaviors to become healthier or adopting new desired behaviors, awareness is necessary for change. The model suggests that awareness can be achieved through knowledge. This includes informing people about their current problematic behaviors, the potential outcomes, and alternative behavior patterns. (Prochaska & Velicer, 1997).

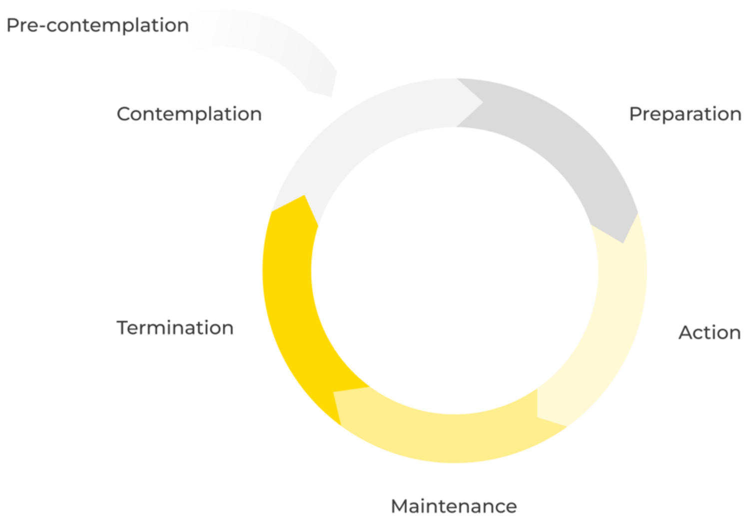


Figure 1.1. Transtheoretical model of change (Adapted from Prochaska & Diclemente, 1986).

As discussed earlier, the lack of knowledge about dogs' health, behavior, and responsible owner practices among caretakers has negative effects on dog welfare. Although caretakers do not intentionally cause harm to their dogs, the reported deterioration of dog welfare in homes is primarily related to this lack of awareness. Therefore, activity and behavior monitoring systems designed for dogs can promote positive behavior change in humans, similar to personal health informatics systems' effects on human behavior. As these devices provide feedback to caretakers, they can improve dog welfare by increasing their awareness of their dogs' needs. Dog activity monitoring devices are similar to human fitness trackers, using accelerometers to measure physiological parameters such as activity levels, walking distance, energy expenditure, and sleep quality. These devices can also connect to computing applications to track dogs' health and behavior over time, motivating caretakers to keep track of their dogs' progress and adjust their behavior to improve the quality of their care. Studies show that using self-monitoring techniques either by technological interventions or by diary methods is found to be motivating for people to change their behaviors to be more active and lose weight in their daily lives

(Munson & Consolvo, 2012; Wang et al., 2014; Fritz, Murphy & Zimmermann, 2014; Normand, 2008; Burke, Wang & Sewick, 2011). Moreover, data-driven feedback and information provided by these devices can also encourage people to change their behavior, as exemplified in studies with human activity trackers (Collins, Cox, Birds & Harrison, 2014; Consolvo et al., 2008; Cuttone et al., 2013; Fritz et al., 2014; Hori et al.; 2013; Kay et al., 2012; Li et al., 2011).

Using state-of-the-art technology to increase human awareness to support dog welfare has a two-fold effect. Evidence suggests that supporting dog welfare through improved caregiving can also benefit humans, as studies show that human-dog interactions affect human psychological and physiological health (Beck & Katcher, 2003). Thus, pet activity monitors can make a significant contribution to the well-being of both humans and dogs not only by improving physical activity but also by increasing caretakers' awareness of their dogs and enhancing the quality of their caregiving. In this line, it is important to examine how systems for monitoring dog activity can mediate the relationship between humans and dogs, as it may reveal many intervention areas to support caretakers in reflecting on the tracking data and guide their behavior to make well-informed/data-driven decisions regarding dog care, and thus, indirectly support dog welfare.

To sum up, as can be implied from this chapter, caretakers lack a thorough understanding of - or misinterpret - the health and behavior of their pet dogs, with potential implications for dog welfare. Therefore, to contribute to dog welfare in domestic settings, there appears to be a need to inform caretakers about their companion dogs' health and behavior. Today, with the increasing popularity of animal technology (Grand View Research, 2020), various commercially available devices for dogs are increasingly being used by consumers. These devices are growingly using smart sensing technologies that collect different types of data and enable different forms of human-animal communication that were not possible before. While these technologies have the potential to assist human users in a variety of ways, they also introduce extra complexity in two ways. First, as animals become targets of such technologies, they are no longer passively exposed to the technology but turn into stakeholders in the interaction processes (Westerlaken & Gualeni, 2016). Animals and humans alike are involved in complex interactions between humans, animals, and technology. Second, humans have to deal with increasing amounts of data on a daily basis due to their daily interactions with data-driven technologies. However, how caretakers interpret the tracking data collected and provided by these devices and how this data affects their caregiving practices remains unknown. Moreover, little design knowledge has been formalized on how to design dog activity monitoring systems to provide monitoring data in a meaningful way to guide human behavior and improve the quality of dog care. Therefore, there is a growing need for research on how such technology is actually used and what effects it has on dogs and caretakers. Thus, the primary work of this thesis is concerned with exploring how to improve the quality of human care of dogs by increasing their awareness through dog activity monitors. The summary of problem background can be seen on Figure 1.2.

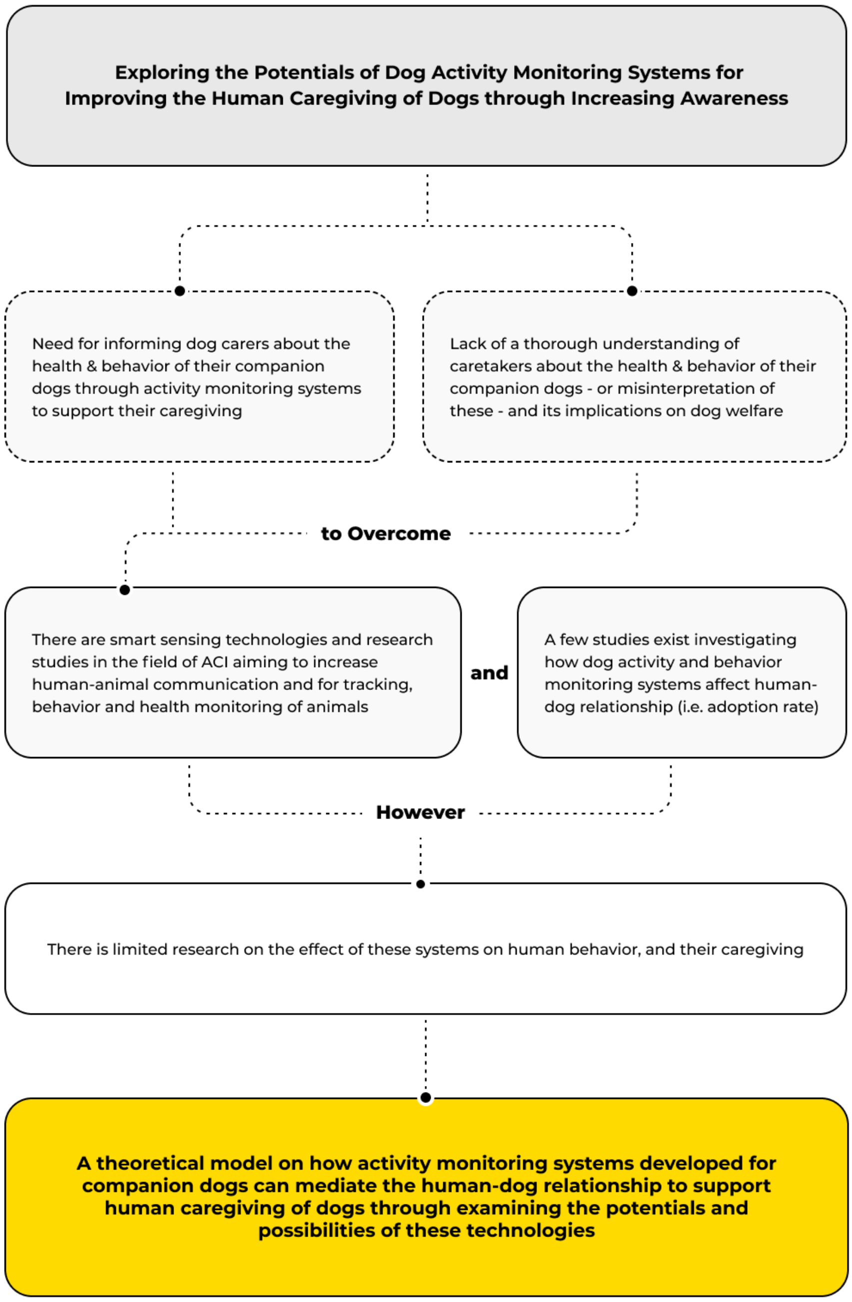


Figure 1.2. Summary of the problem background.

1.2 Aim of the Study and Research Questions

This thesis aims to develop a theoretical model on how dog activity monitoring systems (DAMS) for companion dogs can mediate the human-dog relationship to improve humans' caregiving by examining the potential and possibilities of these technologies. To achieve this aim, the major question the study targets to answer is:

MQ: How can we improve humans' awareness of dogs to enhance their quality of caregiving through the use of DAMS?

To answer these question the sub- questions are as follows:

Research Questions:

Q1: What are humans' different concerns and behaviors that characterize their caretaking fashion towards their dogs?

Q2: How do these concerns and behaviors vary among caretakers? What are the implications of this user diversity on the design of DAMS in terms of increasing human awareness?

Q3: How do dog caretakers make sense of and reflect on the data collected via DAMS?

Q4: What are the dimensions to increase humans' awareness through DAMS to improve their quality of caregiving (of their dogs)?

Q5: What are the design strategies to increase caretakers' awareness of their dogs via DAMS to support their caregiving?

1.3 Structure of the Thesis

Figure 1.3 outlines the structure of the thesis. While literature review is covered in Chapters 2 and 3 constituting the background of the study, Chapters 5, 6 and 7 answers the research questions. Finally, the Conclusion Chapter revisits the research questions and discusses the contributions and the limitations of the study.

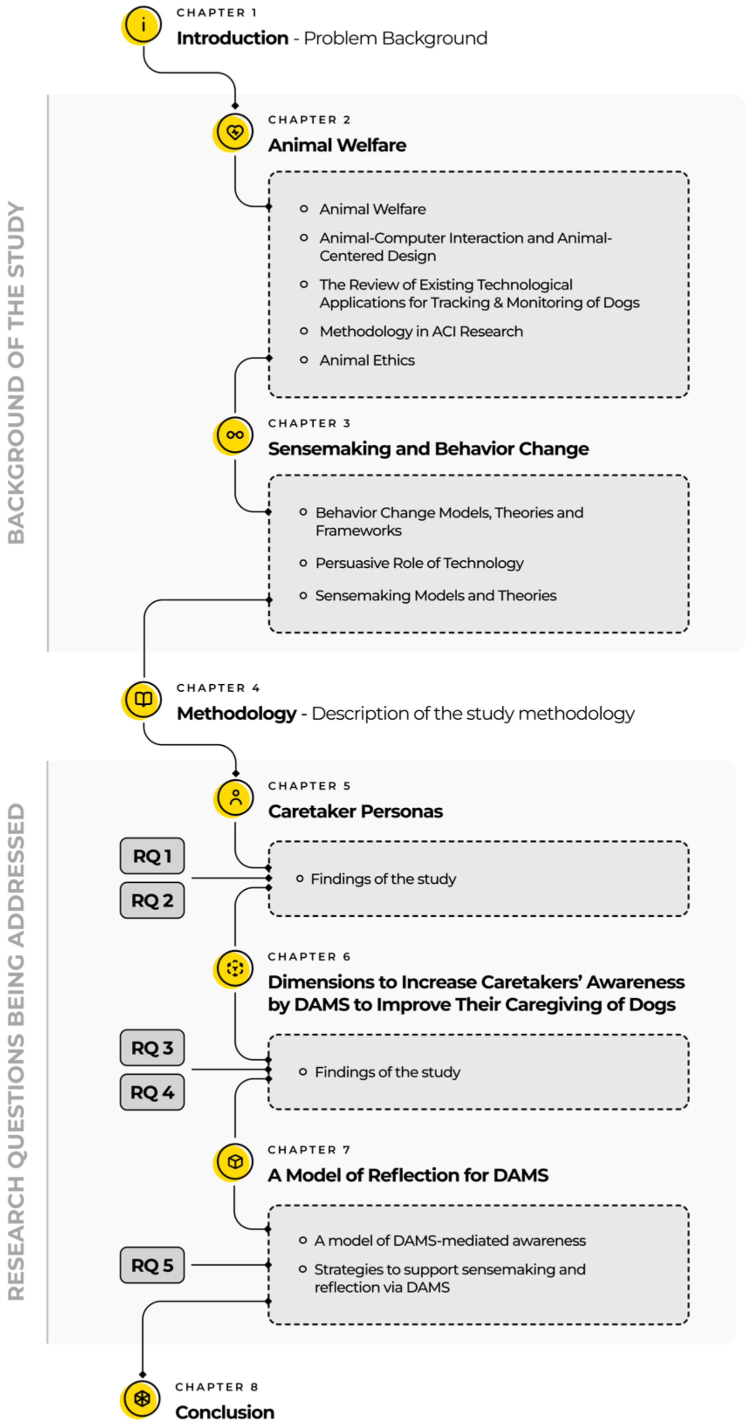


Figure 1.3. Structure of the thesis.

CHAPTER 2

ANIMAL WELFARE AND ANIMAL-COMPUTER INTERACTION

This chapter provides an overview of the existing literature in the field of animal-computer interaction (ACI) to serve as a basis for the thesis, which aims to develop a theoretical model of how dog activity monitoring systems for companion dogs can improve humans' caregiving by examining the potential and possibilities of these technologies.

In this chapter, firstly, different views regarding the definition of animal welfare and assessment of animal welfare are discussed. Then, key terms and concepts related to animal-computer interaction (ACI), including user-centered design and animal-centered design, are defined. Also, the history and the current state of the ACI field are discussed. Then, existing methodological approaches, theories, frameworks, and applications in the field of ACI are reviewed. Following this, a brief overview of the current ethical procedures in animal research is presented, followed by a review of the recent research and practice regarding dog tracking and monitoring technologies in ACI.

2.1 Animal Welfare

The design of interactive technology with an animal-centered perspective requires a clear understanding of animal welfare. The idea of animal welfare can be compared to concepts like quality of life and well-being (Webber, Cobb & Coe, 2022). The state of an animal's welfare can vary from very poor to very good, and this depends on various factors that impact the animal's life (Broom, 1996). According to the OIE World Organization for Animal Health (2013), animal welfare refers to an animal’s physical and mental state concerning the environment where it lives and works. The reasoning for animal welfare is based on the idea that animals are sentient beings that have the capacity to feel both positive and negative emotions and have a desire for positive experiences (Boissy et al., 2007). Turner (2006, p.6) states that an animal is sentient if “it is capable of being aware of its surroundings, its relationships with other animals and humans, and of sensations in its own body, including pain, hunger, heat or cold.”. Therefore, the well-being of animals is essential not just because it is of instrumental value that humans confer on the animal as a means to achieve a particular goal, but it is intrinsically valuable as an end in itself and worthy of moral consideration (Rollin, 1992). That is, animals have value in their own right, and because of that, it is the moral obligation of humans to ensure their quality of life. However, this understanding that animals are sentient beings, and it is our moral responsibility to provide a good life for them requires us to identify their needs first. It is especially crucial for animals under human care (whether in domestic settings as pets, captive animals in zoos, or test animals) where their environmental, social, and behavioral options are often restricted within their living contexts (Coleman, 2018; Perdue, Sherwen & Maple, 2020). Yet, although animal welfare science and animal ethics have a shared moral foundation, they should not be confused with one another. Animal welfare science does not deal with how humans need to treat animals; instead, it acts as a connecting concept between scientific research and ethical considerations (Fraser et al., 1997).

Deciding on the state of an animal’s welfare is not an easy task because it is an ever-changing state, depending on various internal and external factors. The Five Freedoms identified by the Farm Animal Council (1979) outline the minimum requirements for animal welfare as follows:

- Freedom from hunger or thirst and malnutrition: by giving access to fresh water and a balanced diet to maintain good health,
- Freedom from discomfort: by providing a suitable environment that offers shelter and rest,

- Freedom from pain, injury, or disease: by providing preventative healthcare or prompt treatment,
- Freedom to express natural behavior: by offering enough space, proper resources, and social interaction with other animals of their species,
- Freedom from fear and distress: by ensuring that the animal's conditions and treatment do not cause mental suffering.

The Five Freedoms principles were used as a guideline to determine the baseline of an acceptable level of welfare that should be taken into account for the management of settings intended for animals. These principles focus on minimizing suffering and freedom from negative conditions with little or no consideration for the promotion of positive welfare states. However, there are different views on these criteria as contemporary approaches to animal welfare science underline the advancement of positive states (Fraser, 2008). Besides, Dawkins (1990) states that when assessing animal welfare, not just the risks to an animal’s survival but how an animal perceives the situation from its point of view should be considered. This part, the animal’s viewpoint, is integral to animal welfare science as understanding the subjective experience of animals is the primary concern of the studies in this domain (Dawkins, 1990). How an animal perceives a situation is an entirely subjective experience affected by how the environment it inhabits impacts its affective states (Broom, 1996; Mellor et al., 2020). Therefore, this subjective experience can only be assessed and not measured (Rault, Webber & Carter, 2015).

There are different concepts regarding the assessment of animal welfare. The first view is a functioning-based approach, considering the level of reproduction, physical health, growth, and injury as indicative of animal welfare (McGlone, 1993). This view suggests that “an animal is in a poor state of welfare only when physiological systems are disturbed to the point that survival or reproduction are impaired.” (McGlone, 1993). The second approach concentrates on the affective states of animals, emphasizing that their feelings directly impact their welfare without requiring that they necessarily affect their physical health (Dawkins, 1990). Thus, evaluating animal welfare based on physical health or fitness alone is inadequate as the concept of welfare also depends on the animal's emotional and mental state. For instance, animals may experience psychological stress or anxiety that can negatively impact their welfare, even if there are no obvious physical symptoms (Rault, Webber & Carter, 2015). Therefore, considering the animal's subjective experience is important when evaluating their welfare. On the other hand, the natural living approach advocates that the extent to which animals can behave naturally is a determining factor for animal welfare because “it is necessary over a period of time for the animal to perform all the behaviors in its repertoire because it is all functional; otherwise, it would not be there.” (Kiley-Worthington, 1989, p. 333). It is proposed that animals have a nature or ‘telos’ that is made up of genetically encoded needs, desires, and behaviors, and acting according to their telos is integral to good welfare (Rollin, 1993). Dawkins (2021, p.1) provides a contemporary and animal-centered perspective on animal welfare by defining positive welfare as "a combination of good health and having access to what the animals themselves want".

Needing to address these different views regarding the assessment of animal welfare and to extend the scope of conceptual frameworks identifying only negative welfare states to include positive states as well (Farm Animal Welfare Council, 2009; Webster, 2011; Edgar et al., 2013), the Five Domains of Animal Welfare Model was devised to assess the welfare states of “sentient animals used in research, teaching, and testing (RTT)” (Mellor & Reid, 1994, p.241). It provides a structured approach to evaluate signs of both internal and external physical and functional conditions and environmental factors, which then have an impact on the psychological experiences of animals. The model comprises five domains, including four related to functional variables: nutrition, environment, health, and behavior, and mental state (Table 2.1). The first three domains mainly concentrate on the presence or absence of internal physiological and survival-related factors such as nutrition, environment, and health-related problems. The factors grouped under these three domains are crucial for the functioning of animals’ genetically encoded biological mechanisms (Fraser & Duncan, 1998; Panksepp, 2005; Denton et al., 2009). On the other hand, the fourth domain includes situation-related factors linked with environmental conditions that may restrict animals from performing their natural behaviors to the extent that would potentially pose a challenge to their survival (Mellor et al., 2009). Once all the internal and external factors in the first four domains of the model are systematically evaluated, the emotional states resulting from these factors are accumulated in the fifth "mental state" domain. The emotional experience of the animal is assessed in this domain, which would determine the animal's overall welfare status (Mellor et al., 2009).

The Five Domains Model, in contrast to the Five Freedoms, considers both positive and negative mental states of animals. As a result, it is an effective method of assessing animal welfare. The negative aspects stated in the Five Domains model include “breathlessness, thirst, pain, hunger, nausea, dizziness, debility, weakness and sickness, which are mainly associated with sensory inputs generated internally, and anxiety, fear, frustration, anger, helplessness, loneliness and boredom, which are associated mainly with the animal’s cognitive assessment of its external circumstances.” (Mellor & Beausoleil, 2015, p.242). In addition to all aspects concerning animal welfare discussed in this chapter so far, play is also found to be related to animal welfare from four points onwards. First, it is seen as a possible indicator of welfare, as it suggests an absence of threats to the animal's fitness (Fraser & Duncan, 1998). Second, it is also associated with positive emotions in animals (Fraser & Duncan, 1998). Moreover, it is also regarded as a method to improve welfare because it provides long-term and short-term physiological and psychological health benefits that may enhance animal welfare (Held & Spinka, 2011). Lastly, it holds the potential to contribute to well-being in animal groups as it is socially contagious (Held & Spinka, 2011).

Table 2.1. Five Domains model (Adapted from Mellor & Beausoleil, 2015).

Physical/Functional Domain							
Survival-Related Factors						Situation Related Factors	
Nutrition		Environment		Health		Behavior	
Restrictions on:	**Opportunities to:**	**Unavoidable/Imposed Conditions:**	**Available Conditions:**	**Presence of:**	**Little or no:**	**Exercise of 'agency' impeded by:**	**Agency' exercised via:**
Water intake	Drink enough water	Thermal extremes	Thermally tolerable	Disease: acute, chronic	Disease	Invariant, barren environment (ambient, physical, biotic)	Varied, novel, engaging environmental challenges
Food intake	Eat enough food	Unsuitable substrate	Suitable substrate	Injury: acute, chronic; husbandry mutilations	Injury	Inescapable sensory impositions	Congenial sensory inputs
Food quality	Eat a balanced diet	Close confinement	Space for freer movement	Functional impairment: due to limb amputation, or lung, heart, vascular, kidney, neural or other problems	Functional impairment	Choices markedly restricted	Available engaging choices
						Constraints on environment-focused activity	Free movement Exploration Foraging/hunting
Food variety	Eat a variety of foods	Athmospheric pollutants: CO2, ammonia, dust, smoke	Fresh air	Poisons	Poisoning	Constraints on animal to animal interactive activity	bonding/reaffirming bonds Rearing young Playing Sexual activity
		Unpleasant/strong odors	Pleasant/tolerable odors				
Voluntary overeating	Eating correct quantities	Light: inappropriate intensity	Light intensity tolerable				
Force-feeding		Loud/otherwise unpleasant sounds	Noise exposure acceptable				
		Environment monotony: ambient, physical, lighting	Normal environmental variability	Obesity/leanness	Body condition appropriate		
		Unpredictable events	Predictability	Poor physical fitness: muscle de-conditioning	Good fitness level	Limits on threat avoidance, escape or defensive activity	Using refuges, retreat, or defensive attack
						Limitations on sleep/rest	Sleep/rest sufficient
Affective Experience Domain							
Mental State							
Negative	**Positive**	**Negative**	**Positive**	**Negative**	**Positive**	**Negative**	**Positive**
Thirst	Wetting/quenching pleasures of drinking	Forms of discomfort:	Forms of comfort:	Breathlessness	Comfort of good health and high functional capacity	Anger, frustration Boredom, helplessness Loneliness, isolation	Calmness Engaged, in control Affectionate sociability
Hunger (general)	Pleasures of different tastes/smells	Thermal: chilling, overheating	Thermal Physical	Pain: many types Debility, weakness Sickness, malaise			Maternally rewarded
Hunger (salt)	Pleasure of salt taste	Physical: joint pain, skin irritation Physical: stiffness, muscle tension					
		Respiratory: e.g. breathlessness	Respiratory	Nausea		Depression Sexual frustration	Excitation/playfulness Sexual gratification
	Masticatory pleasures	Olfactory Auditory Visual: glare/darkness eye strain	Olfactory Auditory Visual	Dizziness			
Malnutrition malaise	Postprandial satiety			Physical exhaustion	Vitality of fitness	Anxiety, fearfulness, panic, anger Neophobia	Secure/protected/confident Likes novelty
Bloated, over full	Gastrointestinal comfort	Malaise from unnatural constancy	Variety-related comfort			Exhaustion	Energised/refreshed
Gastrointestinal pain							

2.2 Animal-Computer Interaction (ACI)

Although animal welfare, animal ethology, and physiology have long been studied, design for animals has traditionally been driven by economic interests and human preferences rather than by an understanding of their evolutionary nature and their welfare (Webber, Cobb & Coe, 2022). In line with this conventional view, up until the turn of the century, animals' requirements were often disregarded during the design and development of animal technology as they were seen more as the subject rather than system users (Hirskyj-Douglas & Read, 2014). However, with the increasing integration of technology into human lives, it has been realized that humans are not the only species that come into contact with interactive technologies. Thus, it has become of interest how these systems affect animal behavior and the human-animal relationship.

In line with the growing interest in this area, Animal Computer Interaction (ACI) has emerged as a considerably new research field that was coined with the ACI manifesto in 2011 (Mancini, 2011). It mainly studies "the interaction between animals and computing technology within the contexts in which animals habitually live, are active, and socialize with members of the same or other species, including humans" (Mancini, 2011, p.1). It is a vast area of research as this 'interaction' will vary substantially based on the context, environment, species, the category into which the animal fits, including wild, domestic, working, farm, or laboratory animals, as well as their individual differences (Mancini, 2011). Strongly influenced by the well-established field of Human-Computer Interaction (HCI) in terms of methodological approaches (Mancini et al., 2014; Resner, 2001; Westerlaken & Gualeni, 2014), ACI focuses on the usability of technology intended for animals' use and the user experience of animals (Lee et al., 2006). Today, it has been seen that technology can benefit both humans and animals in various ways, such as enabling human-animal communication, monitoring animal health and behavior, supporting service and working animals, and also for environmental monitoring and control in places where animals live (Jukan, Masip-Bruin, & Amla,1994).

Along with the development of computerized technology, the advancement of the ACI field could provide further advantages. As Mancini (2011) stated in the ACI manifesto, the advancement of the field can;

- Improve the human-animal relationship by enhancing interspecies communication, which would lead to an increased understanding between them.
- Help to comprehend animals' cognitive processes better through animal behavior and usability studies with the help of animal technologies.
- Increase the efficiency of animal conservation studies by guiding the design of tracking and monitoring technologies to minimize their impact on animals and maximize the reliability of the gathered data.
- Contribute to the economic and ethical sustainability of the farming industry and food production by giving animals greater control over their environment or providing them with environmental enrichment to reduce their stress levels and susceptibility to illness.
- Be beneficial to specific human user groups as well, by exploring new ways for eliciting requirements from non-verbal users or users with limited cognitive abilities, by expanding the boundaries of HCI research.

Moreover, as ACI is naturally aligned with animal welfare (Rault, Webber, & Carter, 2015), the well-being of animals is one of the primary concerns for the studies in this area.

It is essential to clarify how an animal is defined to identify the scope of ACI better and differentiate it from HCI. The Oxford Dictionary (2019) offers two definitions. In the first one, an animal refers to "a living organism that feeds on organic matter, typically having specialized sense organs and nervous system and able to respond rapidly to stimuli." Based on this definition, humans are also included in the category of animals. On the other hand, according to a second definition, which reflects a more ordinary usage and the standard anthropocentric view, it means “an animal as opposed to a human being” (The Oxford Dictionary, 2019). Following these definitions, it is possible to look at ACI from two perspectives 1) as a subfield of HCI focusing on non-human animals or 2) as an inclusive term covering HCI, and Child Computer Interaction (CCI), considering humans as animals (Hirskyj-Douglas et al., 2018).

Nevertheless, with an emphasis on the differences between human and non-human animals, ACI is generally focused on the study of non-human animals regarding the lack of research in this area. Focusing on non-human animals as their primary users, ACI also seeks to adopt a user-centric approach to designing animal technologies. User-centered design is a broad term meaning that the design process is shaped around its intended users to meet their needs and preferences (Abras et al., 2004). Thus, the key principle within user-centered design is the involvement of end users in the design process to influence the design. It is thus essential to prioritize animal-centeredness in ACI to ensure that design decisions are informed by the needs of animals as its end-users, with the ultimate aim to provide technology that truly benefits them.

In ACI, both terms ‘interaction’ and ‘user’ are utilized in a broad sense, including whether the user interacts with the system actively and intentionally (Robinson et al., 2014), actively and unintentionally (Mancini et al., 2015), passively and deliberately (Cheok et al., 2011) or passively and unintentionally (Mancini et al., 2012). In interaction design, it is given high priority that the needs and preferences of users should be considered during the development of technology to enable the creation of more usable systems and better user experience (Preece et al., 2015). To achieve this, it is essential first to identify the requirements of prospective users to guide the design and development of interactive technology. However, one of the most crucial challenges within ACI research is eliciting requirements from non-human animals who are non-verbal users (Hirskyj-Douglas et al., 2016). The biological differences between humans and animals and the established anthropocentric approaches within interaction design and HCI make it hard to understand what animals actually need or prefer and make the right design decisions accordingly.

2.2.1 Animal-Centered Design and Its Challenges

One of the main challenges faced in ACI is to achieve animal-centeredness in the design of animal technology, that is, identifying and prioritizing animal needs and preferences at the center of the design. Adopting an animal-centered approach to the design of animal technologies should be the main focus to ensure that technological interventions result in long-term mental and physical benefits for animals (Webber, Cobb & Coe, 2022). The field of Animal-Computer Interaction (ACI) suggests that the interaction design methods employed in human-centered design projects can be modified and applied to identify new possibilities for technology to enhance the welfare of animals (Mancini, 2011; French, Mancini & Sharp, 2017). A challenge exists, however, in determining what animals ‘need’ or ‘want’ (North & Mancini, 2016).

ACI, being a nascent field, shares close ties with HCI in terms of theoretical models and research approaches. However, eliciting requirements from/identifying the needs of animals is a significant challenge due to interspecies differences and communication barriers (Zamansky et al., 2017), as most methods employed in HCI are based on written or verbal communication. To overcome this challenge and establish animal-centric approaches, researchers have investigated how various methodologies from fields such as human-computer interaction (HCI) and child-computer interaction (CCI) can be modified for use in ACI. In this section, the methods used in ACI research have been reviewed by providing examples from the literature.

2.2.2 Research Methods in ACI for the Identification of Animal Needs

Observation or ethnography is a widely used tool in animal science that has been employed for a long time to understand animal behavior, particularly in natural settings (Vicedo-Castello, 2017). As animals communicate with other animals through behaviors, including gestures, postures, and sounds (Broom & Fraser, 2015), these behaviors convey lots of information for researchers. Therefore, it is one of the widely adopted requirement elicitation methods in ACI research. Ethnography is a qualitative research method based on the observation of people to gain insights into how they interact with the things in their natural environment (Hammersley, 2007). Observation is also one of the most widespread ethnographic methods in HCI, in which a researcher observes the actual behavior of users without directly interfering with them. What makes observational techniques so useful for animal studies is that they allow researchers to collect data directly from animals through the observation of exhibited behaviors in their natural environment (Vicedo-Castello, 2017). Therefore, analysis of animal behavior through observation is key to ACI research to understand animals' perceptions of a proposed design solution. Methods for eliciting ethnographic data from animals have been previously applied in ACI studies, as exemplified by Mancini et al. (2014).

Meyer, Forkman, and Paul (2014) have noted that animal behavior assessment has been traditionally ethogram-based (a description of typical behaviors performed by a species), as outlined by Martin and Bateson (1993). Ethograms have been used in some ACI studies. For example, Baskin and Zamansky (2015) used ethograms in their study to investigate dog user experience with interactive technology. The study explored dogs' interactions with two digital games presented on a tablet. In this study, the authors evaluated the behaviors of their participants with reference to a dog ethogram. Moreover, observation of animal behavior is often combined with physiological measurements for further interpretation and improved reliability (North & Mancini, 2016). However, qualitative evaluation methods recently have become more commonplace in animal research (Wemelsfelder, 2007; Uher & Asendorpf, 2008; Meagher, 2009; Walker et al., 2010).

Observational methods have also been utilized for usability testing studies in ACI, during which the researchers observed non-human users as they interacted with the proposed systems (Ritvo & Allison, 2014; Westerlaken & Gualeni, 2014). However, with concerns over the human exceptionalism inherent in ethnographic research (Kirksey & Helmreich, 2010), the emergence of multispecies ethnography has underlined that ethnographic studies should not be confined to humans as human lives are entangled with the lives of other species. In the context of ACI, Mancini, van der Linden, Bryan, and Stuart (2012) and Mancini, Harris, Aengenheister, and Guest (2015) used *multispecies ethnography* in which observations of animal behavior were combined with expert advice and involved caretakers as mediators to investigate technology-mediated human-dog relationships. Similarly, North (2016) suggests mitigating human supremacy in ethnography by combining it with quantitative ethology-based approaches to analyze animal interactions and behaviors, proposing a new method with the term '*ethographology*.' However, although there is extensive literature on how to observe dogs' behaviors in laboratory settings (Hasen, 2003; Quinn et al., 2007) using technology (Zeagler et al., 2016; Gergely et al., 2014), there is currently no widely accepted approach in ACI for studying dogs' behaviors within their natural domestic environments using observational methods.

In ACI studies, it is often required to gather observational data from caretakers as they are familiar with their dogs' routines and behavior patterns. Studies on the questionnaires used for dogs' psychometric evaluation show that caretakers' subjective assessments of their dogs' behavior might lead to faulty results (Dodman, Brown & Serpell, 2018). Thus, considering this issue, Hirskyj-Douglas (2017) presented the dog information sheet (DISH) to inform caretakers/observers regarding typical behaviors that dogs exhibit when interacting with technology. The tool is developed based on the RSPCA (2015) dog behavior guidelines and a veterinary consultant elaborating on this information. It is aimed with DISH to improve the accuracy of human observers' evaluation of dog behavior (Hirskyj-Douglas, 2017).

Another methodological approach in ACI is employing conversational/interview techniques applied to collect data from experts or caretakers to identify animal requirements. For example, in their study, Mancini et al. (2014) employed semi-structured interviews with human caretakers by asking them questions about the well-being and behavior of their companion dogs, their daily routines, and the perceived benefits of technology for both humans and dogs. On the other hand, Zeagler et al. (2016) conducted semi-structured interviews with experts to develop a wearable interface for search and rescue (SAR) dogs to allow remote communication with their handlers via a mobile application.

In addition to the methods in animal research mentioned so far, there are also a few design methods adapted from the HCI field to understand the needs of animals. One of the most promising techniques used to investigate animals' design preferences in ACI research is physical prototyping. Providing animals with prototypes of a proposed system is found to be an effective way to allow them to express their preferences directly and to gather feedback on possible design solutions. Physical prototyping for requirement elicitation from non-human users through adopting a research-through-design approach has been exemplified in several studies with diabetes alert dogs (Robinson et al., 2014), with cancer detection dogs (Mancini, Harris, Aengenheister & Guest, 2015), and with captive elephants (French, Mancini & Sharp, 2015). Moreover, physical prototyping may allow the execution of participatory design methods, such as co-design, by involving animal stakeholders in the design processes. Taking its roots in user-centered design and participatory design, co-design refers to the collaborative participation of both trained designers and non-designers in the design process. (Sanders & Stappers, 2008). In their study on two design projects, Westerlaken and Gualeni (2016) suggest involving animals and humans in the design process as actors through multiple prototype iterations (Westerlaken & Gualeni, 2016).

Another method that is transferred from the HCI methodology to ACI is personas. A persona is a representation of a hypothetical user created based on either data or assumptions considering the characteristics of the target user (Nielsen, 2017) used to represent actual or potential users' behaviors, goals, motives, and informational needs (Blomkvist, 2002). The goal of using personas is to better inform the design process about potential users (Pruitt & Adlin, 2006) to create more usable products or systems. It is particularly a useful tool for the design and development of interactive systems targeted towards animals, as their physiological and psychological characteristics and requirements may be overlooked due to interspecies differences, which could result in them being unable to perform the desired task.

In ACI studies, Robinson et al. (2014) explored the use of dog personas to aid in designing an emergency alarm system for diabetic assistance dogs to call for help in case of an emergency. The dog personas in the study were generated based on the researchers' observations of the system's potential users, a group of mobility service dogs, and medical detection dogs. The personas included aspects related to the system's design, such as dogs' size, age, breed, attitude, and play preferences and behaviors. Additionally, concerning the dog personas, researchers also created caretaker personas to present the human-dog relationship and the specific domestic context. Building on this study, Hirskyj-Douglas, Read, and Horton (2017) developed a set of dog personas to be used as a tool to represent dog requirements for the design of screen systems. The personas created in the study are based on the data gathered from dog caretakers through questionnaires. It is intended to present different dog personalities with the related aspects that could guide the design of screen systems for dogs, such as their general temperament, preferences, and attention to technology and demographic information (Figure 2.1).

Figure 2.1. Border Collie dog persona (Hirskyj-Douglas, Read, and Horton, 2017, p.7).

User involvement is an essential part of Human-Computer Interaction (HCI) practices, as it provides essential guidance for designers and developers in the creation of computer interfaces and interactions. However, since existing practices are inadequate in obtaining guidance from non-human users, as they are mostly based on verbal methods, Farrell, McCarthy, and Chua (2018) propose ways for adapting expert techniques and processes from HCI to the field of Animal-Computer Interaction (ACI). These methods include "controlled testing, direct observation, heuristic evaluations, user profiling, interviews, focus groups, PICTIVE prototyping, and cognitive walkthroughs", particularly for the design and development of dog training technologies (Farrell, McCarthy, and Chua, 2018, p.6).

In addition to the above-mentioned methods and approaches in ACI practices, the assessment of usability in animal technology is another challenge that needs further consideration. As usability is a key measure of user experience, usability assessment should be an indispensable part of the development of animal technology. Usability evaluation with dog users has been exemplified in many studies so far in ACI (Mancini et al., 2016; 2015; Zeagler et al., 2014; Jackson et al., 2015; Bryne et al., 2017). In their work, Ruge and Mancini (2019) highlight two primary difficulties that arise when assessing usability for animals. The first challenge concerns the variations in cognitive, physical, and sensory abilities between human evaluators and animal users. The second challenge relates to the focus of most usability evaluation techniques, which are primarily designed for human use and are therefore human-centered. To address these issues, they propose the Method for Evaluating Animal Usability (MEAU), in their study applied to evaluating the usability of different access controls for Mobility Assistance Dogs (MADs) as users. MEAU aims to create a framework to assess the usability of interactive technology for animal users, considering their unique characteristics. It also aims to reinterpret established interaction design principles to cater to animal-centric needs and requirements. Additionally, MEAU seeks to establish a process for evaluating animal usability that recognizes the disparity between human evaluators and animal users (Ruge & Mancini, 2019). The model involves seven distinct stages, as shown in Figure 2.2, and includes creating use cases for the interaction to be evaluated.

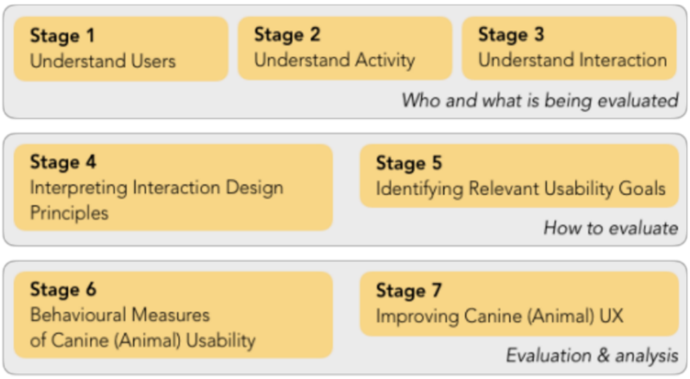


Figure 2.2. MEAU stages and key aims (Ruge & Mancini, 2019, p.3).

Additionally, Freil et al. (2017) propose a dog-specific framework for analyzing technological systems based on Don Norman's seven-stage model (Norman, 2013), a well-known and largely applied model to evaluate computer interfaces in HCI. By adapting the framework for dogs' interactions, researchers aimed to provide a tool for the design and development of animal-centered technology (Figure 2.3). In the model, interaction is separated into two phases: execution and evaluation. Execution refers to the stage that the user decides on which action to perform on an interactive system. Any failure here leads to the 'gulf of execution', which is the gap between the user's goal and the means to accomplish it. The user begins by setting a goal and planning a sequence of actions to achieve it. Then, in the evaluation phase, the user assesses the outcome of each action. Failure to understand the result of an action can lead to the gulf of evaluation. When a user completes an action, they assess the current state of the system, interpret the results, and compare them to their intended objective. The framework is flexible enough to apply to different contexts, whether a user is a dog or human, based on the assumption that every user shifts between execution and evaluation phases during their interactions with a computerized system (Freil et al., 2017).

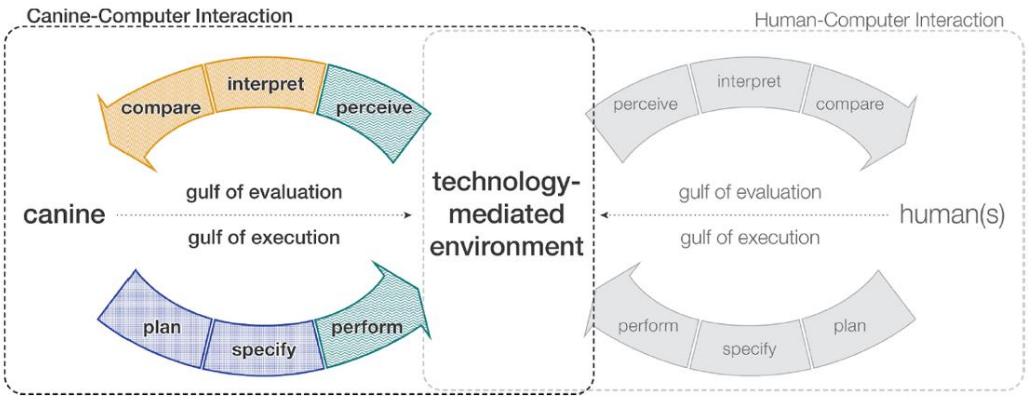


Figure 2.3. Canine-centered framework (Freil et al., 2017, p.105).

2.2.3 Theories, Models, and Frameworks within ACI

This section briefly reviews the existing theoretical frameworks and models that illustrate how animal-centeredness in technology design and development can be achieved by placing animal welfare at the heart of these processes.

2.2.3.1 Actor-Network Theory

Actor-Network Theory (ANT) is a theoretical and methodological approach that views both human and non-human actors as equal stakeholders in a constantly shifting network of relationships. In ANT, the term ‘network’ refers to a system composed of objects, actors, and relationships between human and non-human agents that mediate one another, shaping the resulting actions and experiences (Latour, 2007). Based on the theory of Latour, Verbeek (2011) suggests that humans are not passively exposed to technology. Still, both technological artifacts and their users could mutually shape their role in a technologically mediated interaction. It is argued that this is also relevant in the case of animals that are involved in such interactions. Depending on the context or network, an artifact is first interpreted by a human or animal, and then it is utilized in one way or another (Verbeek, 2011). In other words, by acknowledging both human and non-human stakeholders as individuals and actors, Latour proposes a different view from human-centeredness and argues that actors’ actions are not simply the result of their intentions. Rather they are mediated by other interrelated factors, such as sociocultural and material environments (Latour & Venn, 2002). Similarly, Haraway (2008) takes a multispecies perspective and argues that humans and animals are interconnected by the mere fact of existing together in the same world. Emphasizing the interconnectedness of the living world, she asserts that it is wrong to regard humans as separate from it. She states that; “If we appreciate the foolishness of human exceptionalism, then we know that becoming is always becoming with, in a contact zone where the outcome, where who is in the world, is at stake.” (Haraway, 2008, p. 244).

Building on the perspective that ANT provides, design space has shifted its focus from anthropocentric perspectives over the past decade placing humans at the center and expanded to include approaches and methodologies of more-than-human design (MTHD) (Coşkun et al., 2022). Products equipped with modern sensing and processing capabilities have the ability to affect not just how other products react but also how humans interact with them and with one another (Cila et al., 2017). This shift has necessitated that designers and researchers to broaden their attention from the traditional connection between users and products to encompass a variety of products, services, and agents that have unique functions and interconnections with one another. Furthermore, it has raised issues regarding the effectiveness of human-centered design within this changing perspective (Coulton & Lindley, 2019; Frauenberger, 2019; Giaccardi & Redström, 2020; Kuijer & Giaccardi, 2018).

Both ANT and MTHD are essential to mention in this context as they offer alternative perspectives to the common anthropocentric approaches in HCI and design research. In particular, ANT serves as a theoretical foundation for this study by focusing on understanding the complex interactions and relationships between human and non-human actors within a network. It emphasizes the idea that both human and non-human actors have agency and can shape social interactions and relationships.

In the study within this thesis, various actors, such as caretakers, dogs, and the dog monitoring systems, are involved in a network. Aligning with the study's objective, it is important to explore the ways in which these actors interact, influence each other, and shape the caregiving practices of humans towards their companion dogs. These systems, which monitor and track a dog's activity and behavior, have the potential to mediate and influence the human-dog relationship. Having an ANT lens can help explore how the introduction and use of dog activity monitoring systems mediate human-dog relationships, influence human behavior, and shape the overall caregiving dynamics. This perspective also aids in exploring the complex interactions and influences between human and non-human actors, shedding light on how these technologies can potentially improve humans' caregiving practices and enhance the overall relationship with their companion dogs.

2.2.3.2 AWAX Model

Linden, Zamansky, and Hadar (2017) emphasize the importance of creating non-verbal methods for understanding the needs of non-human users. To this end, they propose "the Agility, Welfare as value and Animal eXpert involvement model (AWAX)", which integrates iterative prototyping, prioritizing animal welfare, and direct involvement of animal experts in the development process (Linden, Zamansky & Hadar, 2017, p.424). The model (Figure 2.4) entails collaboration among animal experts, designers, and developers throughout an agile development process. In this process, animal experts guide the design process and take an active role throughout all stages of design, testing, and review, acting as a "surrogate stakeholder" for the animal to ensure their needs are represented (Linden, Zamansky & Hadar, 2017, p.53).

By incorporating animal experts into the agile development of animal technologies, welfare concerns are addressed early in the process. The AWAX model illustrates how the inclusion of animal experts guarantees the representation of animal needs and the maintenance of animal welfare throughout iterative stages. Current approaches to working with animals in technology development rely on physical prototyping and obtaining feedback from the animals to iterate on the designs. However, the absence of explicit models for eliciting requirements from animals during technology development can jeopardize animal welfare by potentially causing harm or inducing stress. Therefore, developers can utilize this model as a guiding framework in the development of animal technology, ensuring the welfare of animals is upheld (Linden, Zamansky & Hadar, 2017).

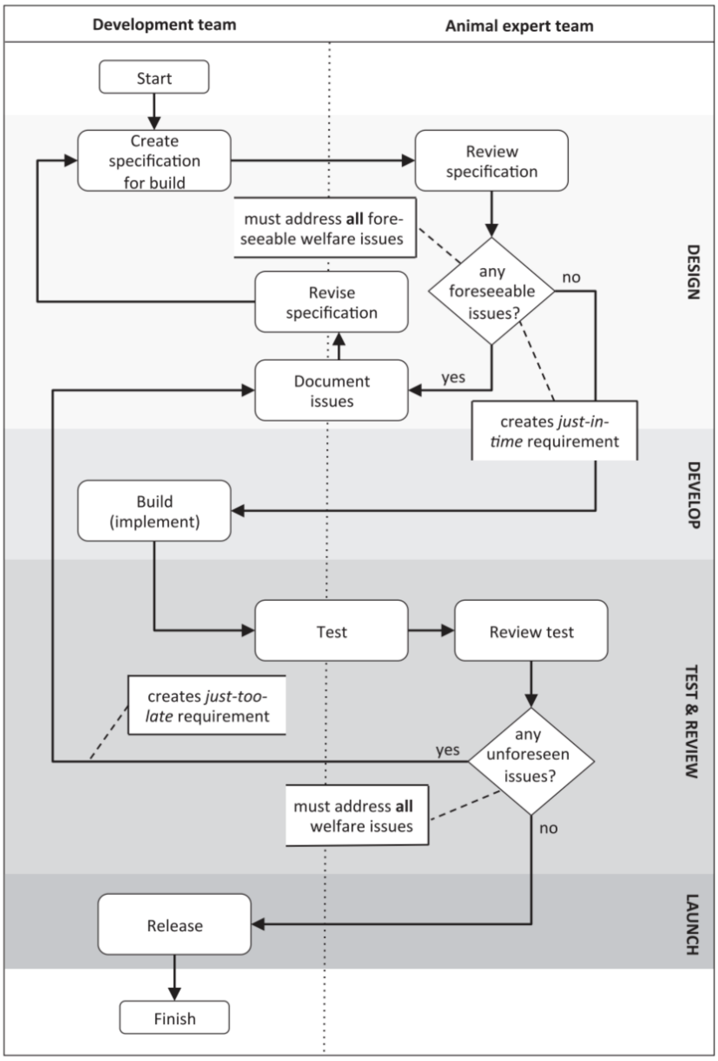


Figure 2.4. The AWAX iterative development model for the development of interactive animal technology (Linden, Zamansky & Hadar, 2017, p.425).

2.2.3.3 Welfare Through Competence Framework

To prioritize animals as key stakeholders in technology design, Webber, Cobb, and Coe (2022) propose the Welfare through Competence framework. This framework integrates the "Five Domains of Animal Welfare" model with the "Coe Individual Competence" model (Figure 2.5), offering a structured approach to defining objectives that center on animals' needs. Its purpose is to guide interdisciplinary teams in placing animals' interests at the center of animal technology design and development.

The Coe Individual Competence Model highlights the importance of providing animals with opportunities for choice, control, and variety, which contribute to their development of competence (Coe, 2017). This approach is grounded in creating an enabling environment that supports animals in attaining the necessary levels of competence and agency. The Welfare through Competence framework provides a systematic approach for assessing and identifying opportunities to enhance animals' quality of life. Its application is particularly relevant in managed environments such as farms and zoos, where promoting positive animal welfare is of utmost importance. Designers can systematically explore design possibilities through an animal-centric lens by analyzing how each competence principle from the Coe Individual Competence model, as represented in the matrix, can positively impact the Five Domains of animal welfare (Webber, Cobb & Coe, 2022).

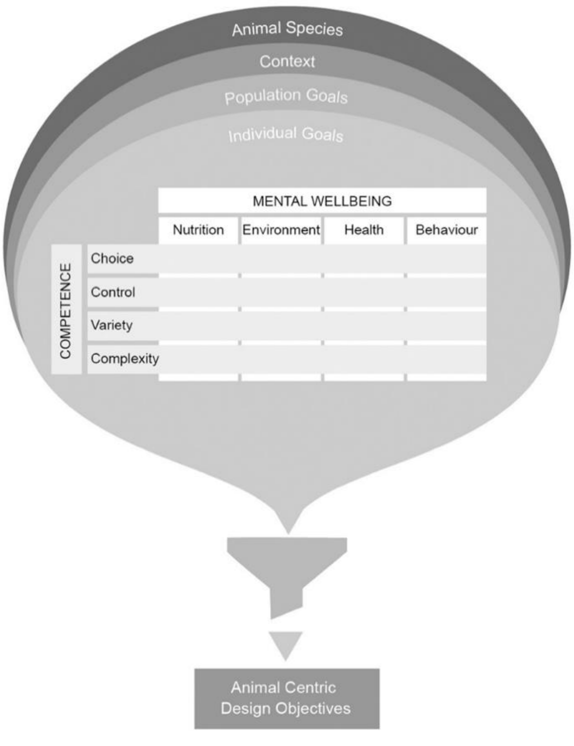


Figure 2.5. The welfare through competence animal objectives matrix (Webber, Cobb & Coe, 2022, p.8).

2.2.3.4 Animal Ethics

When applying theoretical and methodological frameworks in research with animals, researchers have an ethical obligation to prioritize animal well-being and treat them as sentient beings. Therefore, it is crucial to mention the current ethical frameworks in animal research.

Currently, animals' involvement in research projects focused on developing animal technology is regulated by existing ethical frameworks that abide by international laws because there is not a formally established ethical protocol that focuses on the animals as end-users in ACI research. The ethical concerns about animals started originally with their use in laboratory experiments in the 1950s (Russel, Burch & Hume, 1959). The ‘3Rs’ (Replacement, Reduction, and Refinement) approach, a set of guidelines for animals’ use in testing processes presented by Russel and Burch (1959), has become an internationally established principle. One of the most extensive animal ethics legislation to date is the European Directive 2010/63/EU on the protection of animals used for scientific purposes (EC, 2010). It applies to scientific activities which include “any use of invasive or non-invasive of an animal for experimental or other scientific purposes, with a known or unknown outcome, or educational purposes, which may cause the animal a level of pain, suffering, distress or lasting harm equivalent to, or higher than, that caused by the introduction of a needle in accordance with good veterinary practice” (Article 3). The Directive also recognizes animal welfare as “a value union enshrined in Article 13 of the Treaty on the Functioning of the European Union (TEFU)” (Part 2). Moreover, the legislation gives special attention to animals that are more closely related to humans from an evolutionary standpoint, like non-human primates (especially great apes), or animals that have a social connection with humans, such as companion animals like cats and dogs (Parts 18, 21, 33). In the ACI manifesto, Mancini (2011, p.2) defined the following ethical principles that researchers should be responsible for:

- Recognize and appreciate the characteristics of all species involved in the study without any discrimination.

- Treat both humans and non-human participants with respect, consideration, and care, based on their individual needs.
- Conduct research with a specific species only if it aims to develop knowledge or technology that benefits that species.
- Protect both human and non-human participants from any physical or mental harm by using non-invasive, non-oppressive, and non-depriving research methods.
- Allow both human and non-human participants to withdraw from the interaction at any time, either temporarily or permanently.
- Obtain informed consent from participants or their legally responsible guardians before their involvement in the research.

Building on this initial consideration of animal ethics in ACI, researchers have presented different ethical approaches for conducting animal studies. Vaataja and Pesonen (2013) proposed design guidelines derived from the existing frameworks in the literature by taking the 3Rs approach as their defining criteria. Mancini (2016), on the other hand, suggested a welfare-centric ethics framework recognizing consent as a vital requirement of participation. In this framework, animals' consent for engaging in research procedures is considered in two ways; mediated and contingent consent. Mediated consent means obtaining consent for animal participation in research from individuals who can understand the potential impact of the research on the animal's well-being and have the legal authority to give consent on their behalf. On the other hand, contingent consent is based on the following criteria: 1) allowing the animal to adequately evaluate the circumstance by providing them with ample opportunities to explore the environment and research equipment before proceeding with the procedure, 2) giving the animal the chance to make appropriate choices between different types of interaction, such as choosing between reward systems based on food or play, and 3) providing the animal with the opportunity to withdraw or withhold engagement, such as having multiple escape routes and comfortable resting areas (Mancini, 2016). However, the current ethical frameworks for animal use in research mainly focus on the minimization of any negative impact of the research on the individual animals' welfare, involved generally through the implementation of the 3Rs principles (Mancini, 2016).

Mancini and Nannoni (2022) suggest that while the 3Rs principles aim to protect animals, they are rooted in a process-oriented ethical perspective that views animals as tools in scientific processes. Therefore, they proposed an animal-centered ethical approach that recognizes animals as independent and important participants in the research process, with their own interests and the capacity to give or refuse consent. They suggest four ethical principles, namely relevance, impartiality, welfare, and consent, and a scoring system to evaluate the degree of alignment between a research procedure and these principles. The aim is to assist researchers and relevant authorities in evaluating how well a research procedure adheres to these principles. This system is suggested to be used as a complement to the 3Rs, assisting researchers in determining the circumstances in which animal research is in the best interest of the animals involved, identifying ways in which experimental procedures can be modified to improve their ethical standards, and to recognize situations where non-animal methods should be prioritized (Mancini & Nannoni, 2022). Moreover, in another study, Ruge and Mancini (2022) developed an ethics toolkit to help researchers make ethically sound decisions when working with animals and supporting animal-centered research and design. The toolkit is made up of three templates, and each template contains a series of questions to determine the ethical perspectives of the research team and their project. Its use in animal research is designed to provide researchers with a structured approach to defining the project's values and understanding the ethical viewpoint that guides the team's interactions with participant animals, handlers, and other stakeholders involved in the study (Ruge & Mancini, 2022).

In this section, the existing ethical principles and guidelines for animal studies have been reviewed. Consideration of these principles is essential in the design and development of animal technologies to ensure that the studies conducted are ethically appropriate. In addition, existing ethical frameworks for animal research should be reviewed and adapted for the development of animal technologies to be consistent with the advancement of animal technology. The next section provides an overview of existing technological applications for tracking and monitoring dogs.

2.2.4 The Review of the Existing Technological Applications for Tracking and Monitoring of Dogs Concerning ACI

Numerous studies in ACI can be grouped under five categories: haptic interfaces, screen interfaces, tracking and monitoring technologies, direct interaction sensors, and auditory interfaces (Figure 2.7). However, as the study within this thesis focuses on monitoring technologies, only studies in this domain are reviewed in this section.

In ACI, monitoring technologies were explored in many ways, including motion and posture detection and activity and behavior monitoring studies. For example, Mealin et al. (2016) used three-dimensional sensing hardware, Microsoft Kinect, for posture and behavior detection and classification in dogs. The system was able to identify the static postures of dogs, including standing, sitting, and lying, which can also be used to observe stress behaviors. Pons et al. (2015) also used Microsoft Kinect for cats to detect their location, body postures, and field of view. Microsoft Kinect was also used in environmental enrichment studies, including captive animals such as orangutans at the zoo (Scheel, 2018). Besides, Majikes et al. (2016) developed a harness system composed of wearable sensors and devices to detect postures such as sitting, standing, and eating. The study concluded that combining a computer-assisted training system based on algorithmic interpretation with professional training by humans would overcome problems related to ineffective timing during dog training, thus increasing the success rate in training.

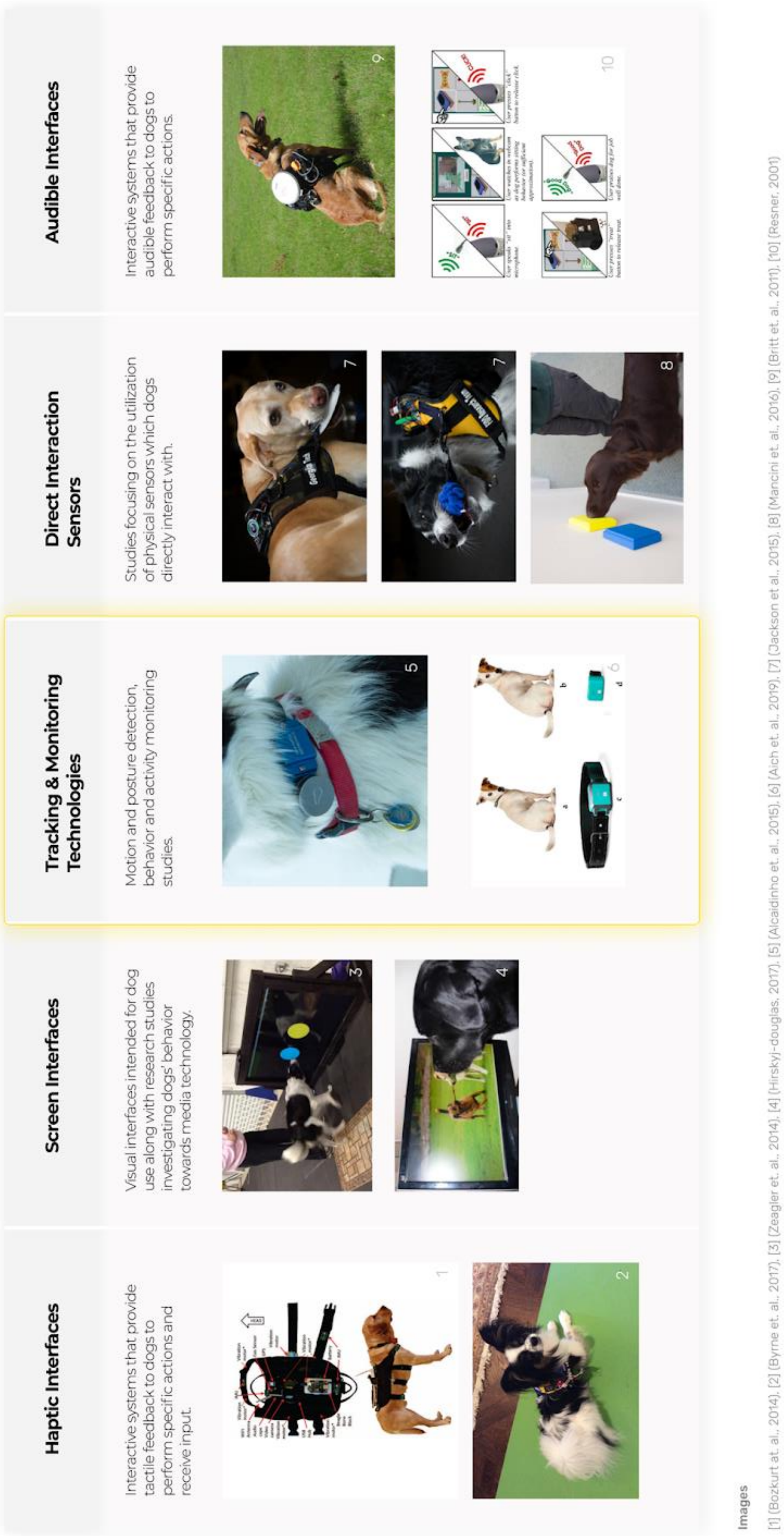


Figure 2.6. Categories of existing technological applications in ACI studies.

Also, in an attempt to create a lower cost and less subjective training method, Brugarolas et al. (2013) developed a system that uses machine learning algorithms for behavior recognition in dogs by using the data collected via an accelerometer and gyroscope deployed on a vest. Extending on the behavior recognition research, Valentin et al. (2015) created a collar system equipped with motion sensors to detect the head gestures of working dogs. Each detected gesture by the system was paired with a pre-recorded message that was delivered to humans via a smartphone. They emphasized that working dogs have limited options for communicating large amounts of stimuli that they perceive to humans, which results in a large information gap between dogs and humans. Moreover, Ladha et al. (2013) developed a collar-based system to record and analyze a set of behavior traits relevant to a dog's well-being, such as eating and sleeping patterns in their natural environments. Tracking technologies seem to be a promising area for further research as they provide means for understanding and measuring the behavior of non-spoken animals, which is fundamental for the development of ACI methodologies.

In addition to the tracking technologies for animals mentioned above, fitness and health trackers, which are one of the most popular devices for humans in the wearables market, have taken their place in the pet industry as well. In recent years, pet wearables have grown in popularity among pet owners. These gadgets are created to keep an eye on the pet's location, monitor their fitness and activity levels, and give insights into their health. Similar to human wearables, these devices consist of hardware equipped with sensors that the pet wears and accompanying software that the caretaker can access via a mobile app. For location tracking, pet wearables usually use GPS or RF-based solutions, whereas activity trackers use accelerometers and Bluetooth or Wi-Fi to send data. For instance, FitBark is an activity tracker worn by dogs that measures their activity levels in a way similar to human fitness trackers. The device captures raw accelerometer data, which is then converted into an understandable format for human users, providing suggestions for interactions, such as taking the dog out for more walks. These devices mainly provide health-related data to pet owners about their pets' daily activity levels, calories burnt, and rest and sleep patterns, along with related suggestions. In dog monitoring technologies, the primary user is humans. Eason (1988) outlined three different user types: the primary user, the secondary user, and the tertiary user. The primary user is the individual that will actively engage with the system, while the secondary and tertiary users are the ones who may use the system occasionally or are impacted by its implementation (Eason, 1988). Today, there are several health and activity trackers for pet dogs on the market, such as FitBark, Whistle, Garmin, and PetPace, in addition to various other commercial pet products, including pet cameras, automatic feeders, and interactive toys.

In ACI research, a few studies have been conducted on pet wearables so far. As an example of the studies on wearables for animals, Alcaidinho et al. (2015) examined whether using pet activity trackers can reduce the return rate of newly adopted dogs from a shelter. The study showed that providing health and activity-related data to adopters through a mobile application resulted in a decrease in dogs' re-relinquishment rates (Figure 2.8). Also, the participants stated that the information provided by the application helped them bond with their newly adopted dogs.

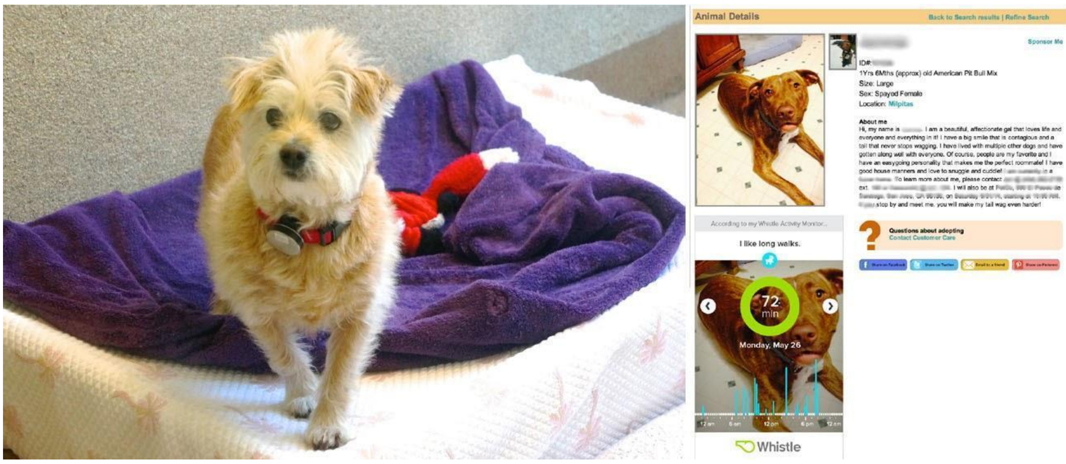


Figure 2.7. A dog wearing a pet activity tracker (on the left), the activity tracker widget (on the right) (Alcaidinho et al., 2015, p.463).

Nelson and Shih (2017) studied how technology, data collection, and visualization influence the way dog owners perceive and interact with their animals. They presented the CompanionViz system, a prototype that provides caretakers with details on their dogs' calorie intake, and activity. Twelve participants were surveyed to assess their initial interest in the system, and then three users were chosen to test it out in a field study. The feedback from these users suggested that the system led to higher awareness, motivation, and curiosity about their pet's needs. Another study found that even a simple collar equipped with GPS can improve human-dog relationships by opening up new forms of interaction (Weilenmann & Juhlin, 2011). Also, Vaataja et al. (2018) investigated the caretakers' motivation to use these dog activity trackers through interviews. The study revealed that caretakers use these devices primarily to monitor health, behavior, and learning-related issues, balance daily activity levels, and rest in dogs. However, the insights gained during device use served as a motivational factor for behavior change in caretakers to spend more time with their dogs. In addition to the use of commercial wearable devices for health and activity tracking in dogs, Kumpulainen et al. (2018) aimed to classify seven activities of dogs by using a three-dimensional movement sensor placed on a collar. They argued that recognizing dog behavior would provide more information to pet owners about their pets than just monitoring their vital signs via health and activity trackers.

Additionally, Zamansky et al. (2019) conducted an empirical study to explore pet owners' perceptions of a commercial dog activity tracker. Their research focused on how and why commercial dog activity trackers were used by dog owners, the influence of their use on pet and owner lifestyle, and the features of the trackers perceived as significant by the pet owners. The findings revealed that the activity trackers were perceived as factor increasing caretakers' motivation to engage in physical activity with their dogs, strengthening the human-animal bond, and heightening caregivers' awareness of their pets' needs and resulting in a perceived improvement in the quality of care. A number of participants reported an improvement in their quality of caregiving and a greater understanding of their animals' physical activity needs and overall well-being. Studies are conducted to explore what motivates consumers to purchase companion animal technology as well as any obstacles that may prevent them from doing so (Ramokapane, van der Linden

& Zamansky, 2019). The results of the study indicated that the primary barriers to the adoption of pet wearables were their cost and durability, alongside users' concerns related to the animal's welfare, perceived lack of usefulness, and accuracy.

This section has provided an overview of current technologies and research studies related to tracking and monitoring dogs. The following section focuses specifically on the concept of dog monitoring technologies as a type of interspecies information system, which involves exploring the ways in which these technologies can facilitate communication and exchange of information between humans and dogs.

2.3 Dog Activity Monitors as Interspecies Information Systems

Animals have traditionally been seen as either unintentional stakeholders or resources in information systems. However, the development of new technology, such as pet wearables, is allowing people to understand animals better and open up new forms of communication between species that were otherwise left implicit or misunderstood (Tami & Gallagher, 2009). Van der Linden (2021) proposes that this creates an interspecies information system (IIS) where humans and animals are both actors and stakeholders. The flow of data between participants of different species in an IIS is demonstrated in Figure 2.9, with technology capturing data from one species and using it to inform another species (van der Linden, 2021).

According to Van der Linden (2021), an IIS enables the exchange of data between humans and animals, allowing humans to gain insights into the physical or behavioral condition of animals. This knowledge can be used to intervene and affect animals in positive or negative ways. However, some information systems, such as pet wearables, exhibit a one-way flow of information. For example, in these systems, the dog is monitored, and the software advises the owner on how to interact with the animal. Meanwhile, the dog is not aware that it is part of this information system (van der Linden, 2021).

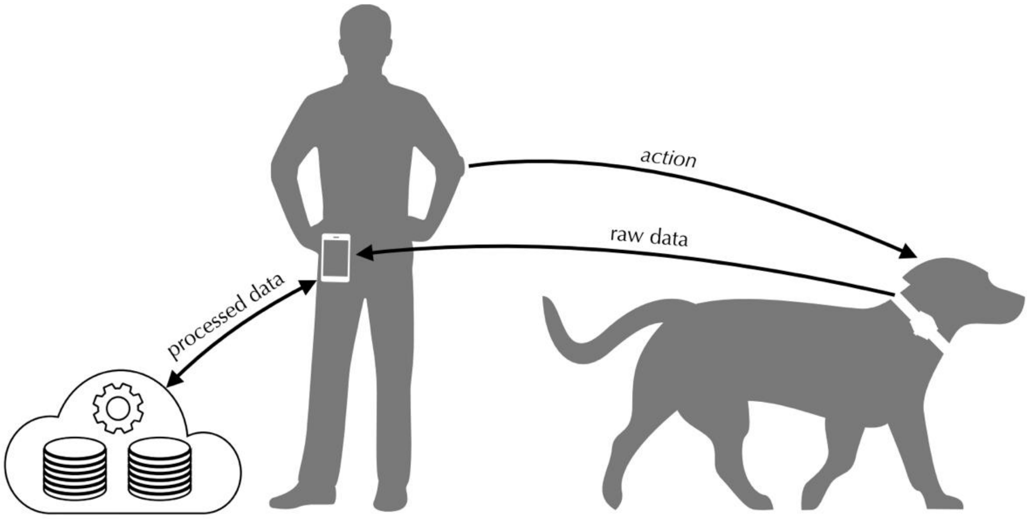


Figure 2.8. Data flow in an IIS consisting of stakeholders of different species (van der Linden, 2021, p.5).

Interventions from one species to another are informed by the information flow within an IIS. Van der Linden (2021) suggests that in order to perform interspecies interventions, it is important to understand the relationships between the various components in an IIS, such as the actors of different species and the technology involved. However, the impact of these interventions can be complex, affecting both human and animal actors, as well as their surrounding social and organizational environments. It is essential to consider the potential impact of these interventions on each other (van der Linden, 2021).

The model in Figure 2.10 illustrates the flow of data and interactions between the components of an IIS, enabling interspecies interventions that can affect processes outside the IIS. For example, dogs can provide input to monitoring technologies like activity trackers and vital sign sensors, which are then processed by information technology, often in the form of software on a human's smartphone or computer. It is important to be aware of the complexities of interspecies relationships and their potential outcomes when considering the impact of interventions. The results of this processing suggest interspecies interventions, which a human actor may enact, or which may inform policy decisions outside the IIS. These interventions impact both external processes, such as pet caregiving, and the human and animal actors involved.

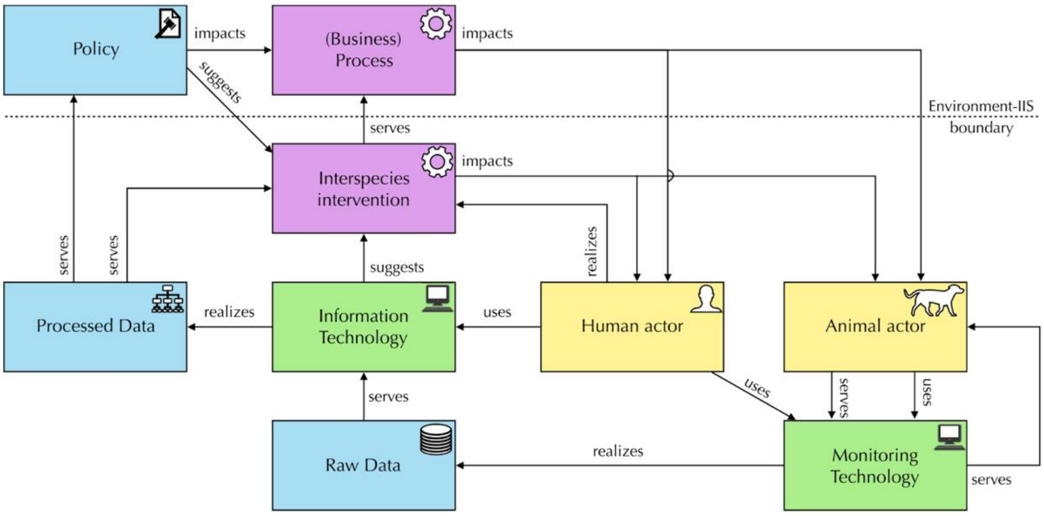


Figure 2.9. Key elements of interactions within an IIS (van der Linden, 2021, p.10).

2.4 Conclusions Regarding the Chapter

In conclusion, this chapter has presented a comprehensive overview of the key topics and theoretical foundations that underpin this doctoral study. By inquiring into the domains of animal welfare, animal computer interaction, and animal-centered design, a solid understanding of the importance of considering animals as central stakeholders in technology development has been established.

The discussion on research methods for identifying animal needs has shed light on existing methodologies used to investigate the experiences and requirements of companion dogs. By incorporating various theories, models, and frameworks such as the AWAX model, the Welfare through Competence framework, and Actor-Network Theory, a theoretical foundation has been revealed to achieve animal-centeredness in technology design. These frameworks offer valuable perspectives and methodologies for designing technology that prioritizes animal welfare and acknowledges the intricate interactions between humans and dogs.

The inclusion of the animal ethics section has provided an overview of existing ethical frameworks in animal research, emphasizing the importance of ethical considerations and responsible research practices to minimize harm to animals. This shed light into the responsible and ethical animal-centered design and research practices to be followed in animal studies.

Furthermore, the review of existing technological applications for tracking and monitoring dogs has offered valuable insights into the current landscape of dog activity monitoring systems. This review sets the stage for exploring the potential and possibilities of these technologies in enhancing humans' caregiving practices through increasing their awareness of their dogs.

Overall, this chapter serves as a foundational basis for the study within this thesis, integrating knowledge from diverse disciplines, ethical considerations, and technological advancements. It establishes a solid groundwork for developing a theoretical model on how dog activity monitoring systems (DAMS) for companion dogs can mediate the human-dog relationship to improve humans' caregiving practices.

CHAPTER 3

BEHAVIOR CHANGE AND SENSEMAKING

Caretakers' lack of a thorough understanding related to their dogs' health, behavior, and needs can lead to unfavorable results regarding companion dog welfare. Moreover, the current decline in the welfare of companion dogs in domestic settings is directly linked to the caretakers' unawareness of these critical aspects. Activity monitoring systems designed for dogs may be able to promote behavior change in humans, similar to how personal health informatics systems influence behavior. Given that the main users of these systems are humans, they can contribute to dog welfare by encouraging positive behavior change in caretakers and raising their awareness about their dogs. Therefore, this chapter aims to provide an overview of the existing behavior models, theories, and frameworks along with the technology's role in behavior change to understand the cognitive mechanisms behind human behavior and behavior change.

3.1 Persuasive Role of Technology

The integration of computing technologies into human life has resulted in various influences on our behavior. However, this relationship between humans and technology is not one-sided. The technology can shape how people behave, but human behavior also impacts how technology is utilized (Slob & Verbeek, 2006). While computers were not initially designed for persuasive purposes, researchers have recently become interested in using them to change human behavior and raise awareness. These interactive computing systems are known as persuasive technology and are intended to modify people's attitudes, behaviors, or both (Fogg, 2003). In other words, persuasive technology is intentionally designed to influence people's behaviors, and it has now taken on the role of persuasion in human life.

However, Fogg clearly distinguishes persuasion from compelling or deceiving people and defines persuasion as a “voluntary change in attitude or behavior” (2003, p.15). To better understand technology’s persuasive potential, it would be helpful to mention the different roles that computer technologies play in human life.

On the functional triad framework (Figure 3.1), Fogg (2003) proposes that computing technologies have three essential functions from the users’ perspective: tools, mediums, and social actors. In their role as tools, computer technologies aim to equip users with new capabilities, allowing them to complete actions more efficiently and effectively. Computer technologies can have an impact on people's attitudes and behaviors in several ways. Firstly, as tools, they can facilitate the attainment of predetermined goals, assist people in a process or experience, or provide motivation through calculations and measurements. Secondly, as mediums, they can shape attitudes and behaviors by offering simulated experiences and allowing people to explore cause-and-effect relationships. Finally, as social actors, computer technologies can offer positive feedback, model desired attitudes and behaviors, and provide social support to people to shape their attitudes and behaviors.

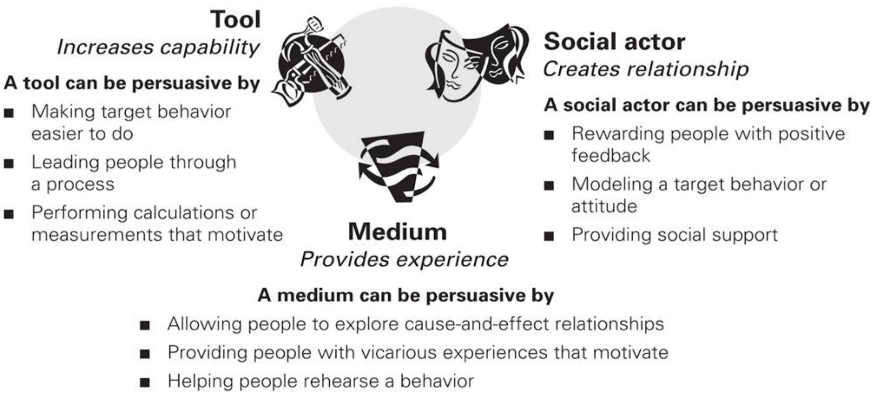


Figure 3.1. The Functional Triad: Roles Computers Play (Fogg, 2003, p.25).

The main concern of behavior change through technology is motivating people to perform a target behavior. According to Fogg (2003), technology can persuade individuals to modify their behavior by motivating, guiding, and providing positive feedback to achieve the desired behavior. Also, Fogg (2003) states that the information and feedback provided via interactive technologies are essential motivators for people to perform a behavior. Thus, people's decisions to engage in an activity are influenced mainly by the information and feedback provided by technology. Similarly, Lilley (2009) posits that technology has three main ways of influencing behavior. First, it can provide feedback on the results of a particular behavior, which can help guide future actions. Second, it can encourage people to behave in certain ways by designing technology with specific affordances and constraints. Finally, technology can sustain a certain behavior by using persuasive methods to change people's thinking and actions. However, although information and feedback offered by technology are crucial to motivate users, motivation by itself is often not enough for a behavior to be performed. Thus, several behavior change strategies are also applied in the design of persuasive technologies.

One example of persuasive technology is personal health informatics systems, which allow individuals to modify their behavior by analyzing self-monitoring data to accomplish a specific goal. These systems analyze the user's data, present it in an understandable way, and offer feedback to assist users in achieving their desired behavior (Fogg, 2003). Furthermore, persuasive technologies use different methods to influence people's behavior change, in addition to offering self-monitoring data. Fogg (2003) describes seven types of behavior change strategies included in persuasive technologies. These include;

- Reduction: Technology should make it easier to achieve the target behaviors by reducing the required effort to perform them. The less perceived effort to achieve the desired behavior would presumably result in increased motivation to be engaged in it.
- Tunneling: Technology should guide users within an experience through a sequence of pre-defined actions/steps. This guidance can also increase the chance of providing further opportunities for persuasion along the way.

- Tailoring: Technology should provide users with information tailored to their individual needs.
- Suggestion: Technology should offer suggestions to users at the right moment.
- Self-monitoring: Technology should allow users to self-monitor to adjust their behaviors or attitudes to achieve the desired outcome. Self-monitoring aims to reduce the effort required to track one's performance, make it easier for users to know their status while performing a specific behavior, and give feedback.
- Surveillance: Technology should enable users to observe others' behaviors to increase the likelihood of achieving the desired outcome.
- Conditioning: Technology should support users in changing behaviors or turning them into habits using positive reinforcement.

Building on Fogg's persuasive design principles, Oinas-Kukkonen and Harjumaa (2008) propose the following strategies for designing computer systems to improve the computer-human dialogue;

- Praise: A system/technology should use praise for providing positive feedback to the users.
- Rewards: Technology should reward users to encourage them to perform the desired behavior.
- Reminders: Technology should remind users of the target behavior.
- Suggestion: Technology should provide users with suggestions, i.e., suggestions to choose healthier foods instead of others to promote healthy eating habits.
- Similarity: Technology should imitate users in specific ways, i.e., using a particular language familiar to a target user group.
- Liking: Technology should appeal to its target users regarding its look and feel.
- Social role: Technology should take on a social role.

Oinas-Kukkonen and Harjumaa (2008) expand these strategies by suggesting other design techniques for technology to motivate users with a particular focus on social support;

- Social learning: Technology should enable users to observe others who perform a target behavior to promote social learning.
- Social comparison: Technology should enable comparison between users.
- Normative influence: Technology should enable users with similar goals to come together.
- Social facilitation: Technology should allow users to find others performing the target behavior/have similar goals.
- Cooperation: Technology should enable cooperation among users.
- Competition: Technology should enable competition between users.
- Recognition: Technology should allow users performing a target behavior to be recognized.

Moreover, there are other behavior change techniques used in activity tracking systems such as giving credit, social influence, providing personal awareness (Consolvo et al., 2006), goal setting (Consolvo et al., 2009; Munson & Consolvo, 2012), (Consolvo et al., 2006), and visual displays of personal data (Consolvo et al., 2008a; Consolvo et al., 2008b).

Fogg (2009b) also categorizes behavior change types in the “Behavior Grid” framework. Considering that there are various types of human behavior, strategies for the design interventions should also vary depending on these behavioral differences. Fogg (2009b) proposes a Behavior Grid that categorizes 35 different types of behavior based on behavior change type and scheduling/timing. According to Fogg, new behaviors are approached differently than familiar ones, so different strategies should be employed to motivate new behaviors. The scheduling/timing of a behavior can range from a one-time action to a habitual behavior. This difference is crucial for persuasion because people are more likely to perform a behavior once rather than committing to future tasks, which can be more challenging. For instance, playing with a dog once is entirely different from adopting a dog. In other words, many aspects come into play when designing for persuasion. Thus, the persuasion strategies should differ considering this variation in behavior types.

In addition to the strategies for the design of persuasive technology, Fogg (2003) also underlines the importance of timing and context to influence users' attitudes and behaviors. He states, "new computing capabilities, most notably networking, and mobile technologies, create additional potential for persuading people at the optimal time and place" (p. 184). In other words, increased connectivity and mobility enable products to intervene at the right time and place, thus, enhancing their abilities to motivate and persuade users.

As can be seen, the design of persuasive technologies involves various factors to consider. If the strategies mentioned above are applied correctly, these technologies have the potential to increase people's awareness and motivation towards performing desired behaviors. For instance, a study on wearable fitness trackers, which are a form of health informatics system, demonstrated that offering health-related personal insights through these devices can lead to long-term behavior changes (Choe, Lee, Munson, Pratt & Kientz, 2013). Another study examining the effects of using a fitness tracker on people's activity levels showed that the device use resulted in a significant increase in participants' activity levels (Cadmus-Bertram et al., 2015). Additionally, additional research suggests that activity-monitoring devices assist users in acquiring a deeper understanding of their actions and conduct within the context of the data provided by these devices (Fritz, Murphy & Zimmermann, 2014).

Understanding the persuasive role that technology can play in people's lives through the proper application of various persuasive design principles and behavior change strategies is essential to understanding the potential impact of technology on behavior. However, technology is not the only determinant of human behavior. To fully grasp the impact of technology on behavior, it is also necessary to understand the psychological mechanisms underlying human behavior. The next section provides an overview of behavior change models, theories, and frameworks in the psychological literature.

3.2 Behavior Change Models, Theories, and Frameworks

There is a considerable amount of research in the field of HCI focusing on behavior change through technology, particularly via personal informatics systems, to promote positive behavior change. It is important to understand first the psychological mechanisms behind human behavior and behavior change to comprehend the potential and use of persuasive technologies. Several models and theories related to behavior change in the psychology literature explain the determinants of human behavior. The following sections present an overview of the existing behavior change models, theories, and frameworks within the psychology literature to help us understand human behavior and how interactive technologies can be utilized to encourage behavior change.

As suggested by Kuru (2013), the four most prominent theories adopted in the personal informatics and health behavior domain, especially in the physical activity context, are the Transtheoretical Model of Behavior Change (TTM) (Prochaska, Johnson, and Lee, 1998), The Theory of Planned Behavior (Ajzen, 1991), The Theory of Reasoned Action (Ajzen & Fishbein, 1980), and Social Cognitive Theory (Bandura, 2001) (Buchan et al., 2021). Buchan et al. (2012) distinguish two kinds of physical activity interventions in their review: stage-based models and social cognitive models. While stage-based models suggest that people go through stages when adopting a new behavior, social cognitive models assume that behavior is mainly controlled by cognitive processes.

The most popular stage-based model within the personal informatics domain, the Transtheoretical Model of Behavior Change (Figure 3.2) devised by Prochaska and Velicer (1997), proposes that a behavioral change process occurs in six distinct stages: pre-contemplation, contemplation, preparation, action, maintenance, and termination (Prochaska & Velicer, 1997). These are called the stages of change. In the pre-contemplation stage, people do not intend to perform a target behavior, mainly because they have little or no awareness of its outcomes. The contemplation stage is where people start to intend for change, and they are more aware of the pros and cons of the target behavior. In the following preparation stage, people prepare to perform the target behavior very soon. In the action stage, people integrate the target behavior into their lifestyles. Following this phase, during the maintenance stage, people continue to perform the desired behavior to prevent relapse. Lastly, the termination stage is the final stage of behavior change, where people have permanently adopted the target behavior for the rest of their lives.

Prochaska and Velicer (1997) suggest that the initial step to encourage positive behavioral change is to promote awareness about issues related to current behavioral patterns, to help individuals progress from the pre-contemplation to the contemplation stage. Without awareness, any behavioral change is unlikely to happen, regardless of whether it involves altering an unhealthy behavior, making a current behavior healthier, or adopting a new desired behavior. The model recommends that awareness can be created by educating people about their existing problematic behavior, its possible consequences, and alternative behavior patterns (Prochaska & Velicer, 1997).

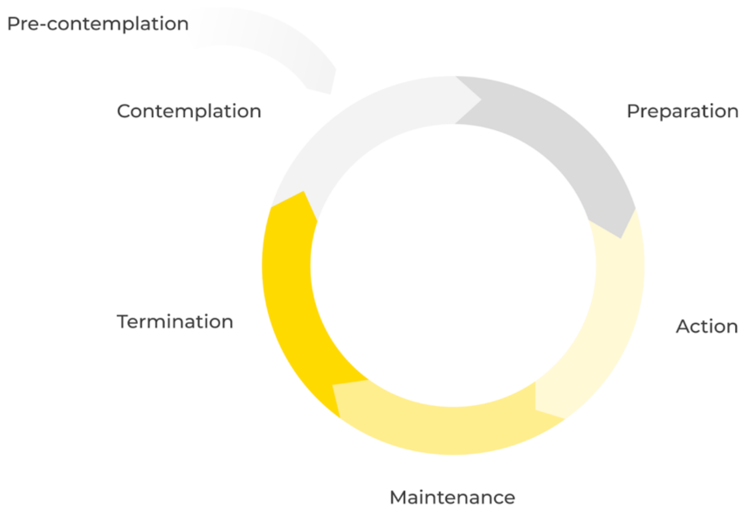


Figure 3.2. Transtheoretical model of change (Transtheoretical model of change (Adapted from Prochaska & Diclemente, 1986).

Similarly, Social Cognitive Theory (SCT) (Bandura, 2001, 2012) also attempts to describe how people acquire and maintain behavior. It particularly emphasizes the importance of social influence in performing a behavior. SCT theory posits that human behavior is shaped not only by personal factors, such as self-efficacy and outcome expectations, but also by environmental factors, such as social norms, and behavioral factors, such as skills. The theory emphasizes that people learn through observation of others as well as through their own experiences. These three main constructs interact with each other dynamically to influence human behavior. In this dynamic model, motivational processes play an essential role in the sense that they affect human behaviors and environments and are constantly influenced by them. Social Cognitive Theory identifies human behavior's major determinants as self-efficacy, social support, and outcome expectations. According to the model, behavior change is likely to be initiated when people think they are capable of performing a target behavior (self-efficacy) and expect that the behavior will result in the desired outcome (outcome expectations). In Bandura's theory, the sense of agency or the belief that they can exert control over/influence the events or their lives to a certain extent plays a key role. People achieve this sense of agency through their self-regulation capabilities, such as by setting goals and following strategies to achieve them. Moreover, they monitor their progress toward a goal and adjust their strategies if needed. In this process, self-efficacy, or the confidence/belief of a person in her/his ability to perform a behavior, is a key variable significantly influencing human behavior and critical for motivation (Bandura, 1977a; Bandura, 1997). Also, self-efficacy results from the self-reflection process in which people examine their behaviors, reflect on them and try to make adjustments if necessary.

On the other hand, in the Theory of Planned Behavior (TPB), Ajzen (1980) suggests that a person's behavior is determined by her/his intention to perform a target behavior. According to the theory, three key constructs determine the likelihood of executing a behavior; behavioral beliefs (attitude toward a behavior), normative beliefs (subjective norms), and control beliefs (perceived behavioral control). attitude toward behavior relates to how favorably or unfavorably a person views a particular behavior, while subjective norms refer to the perceived influence of social pressures on whether a person will choose to engage in that behavior or not. The last construct, perceived behavioral control, is the ease or difficulty with which the individual believes they can control the behavior. The theory posits that if people's attitude toward a target behavior is positive, the subjective norm favors the behavior, and if they think they have a certain degree of control over the behavior, this results in a higher intention (motivation), and they are more likely to perform the behavior. TPB extends the Theory of Reasoned Action (TRA) by adding a third construct of 'perceived behavioral control' to include the factors outside of an individual's control that may affect one's motivation to perform the behavior. TRA and TPB emphasize that individual motivational factors determine the likelihood of performing a target behavior. Motivation is a prominent factor in behavior. When people have the motivation and favor the outcome of behavior, behavior change is likely to occur.

Lastly, Fogg Behavior Model (FBM) (Fogg, 2009a) proposes that behavior occurs as a result of three key factors that must be present at the same instance; motivation, ability, and triggers. A target behavior is achieved only if a person is motivated enough, has the ability, and is triggered to perform the behavior. Thus, technology should be designed to increase users' motivation and abilities and trigger a particular behavior to be persuasive (Fogg, 2009a).

In addition to the models and theories mentioned above, several behavior change frameworks exist. These frameworks are usually based on systematic reviews of theories and models related to behavior change. One such popular framework is the Behavior Change Wheel (Figure 3.3), which can be useful when considering technologies that aim to encourage physical activity (Michie, van Stralen, and West, 2011). Based on the evaluation of nineteen existing behavior change frameworks and theories, Michie et al. (2011) developed the COM-B, a framework for understanding human behavior. In this behavior system, capability, opportunity, and motivation interact to guide behavior. Michie et al. (2011) developed the behavior change wheel based on the COM-B model, expanding it with nine intervention functions and seven policies. The infographic consists of three components - Capability, Opportunity, and Motivation - as in the COM-B model. The nine intervention functions are depicted in the middle ring and refer to behavior change techniques that can be used in interventions. The seven policy categories around the outside ring represent external factors that can facilitate these interventions.

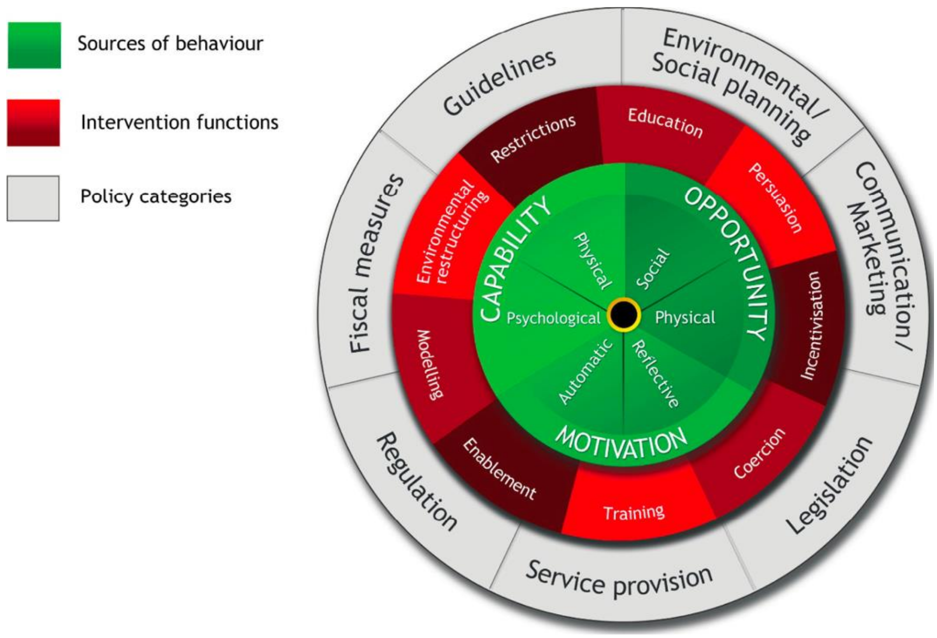


Figure 3.3. The Behavior Change Wheel (Michie, van Stralen, and West, 2011, p.7).

Definitions of the nine intervention functions on the behavior change wheel;

- Education: Increasing knowledge or understanding.
- Persuasion: Using communication to induce positive or negative feelings or stimulate action.
- Incentivization: Creating an expectation of reward.
- Coercion: Creating expectations of punishment or cost.
- Training: Imparting skills.
- Restriction: Using rules to reduce the opportunity to engage in the target behavior (or to increase the target behavior by reducing the opportunity to engage in competing behaviors).
- Environmental Restructuring: Changing the physical or social context.
- Modeling: Providing an example for people to aspire to or imitate.
- Enablement: Increasing means or reducing barriers to increase capability, beyond education or training, or opportunity, beyond environmental restructuring.

Although the theories mentioned earlier and models attempt to explain human behavior from different perspectives, they all share common characteristics regarding the determinants of human behavior or drivers of behavior change. Providing information/feedback to increase awareness, creating social connections for social acceptance (normative beliefs, social norms), and increasing one's capability to perform the desired behavior (control beliefs, self-efficacy, ability) are all key determinants of behavior shared in the mentioned theories. Also, in all of the theories, motivation is regarded as important for changing attitudes and behaviors - as an indispensable factor for behavior change.

In Chapter 1, it was noted that caretakers often lack knowledge about dog health, behavior, needs, and responsible practices, which can have a negative impact on dog welfare. This lack of awareness is the main cause of reported deterioration of dog welfare in domestic settings, even though caretakers do not intend to cause any harm or suffering to their dogs. Activity monitoring systems designed for dogs have the potential to promote positive behavior change in humans through the information, feedback, and motivation they provide, similar to how personal health informatics systems affect behavior. As these devices are primarily used by humans and not dogs, they can help promote positive behavior change in caretakers and increase their awareness about their dogs, thereby contributing to dog welfare. Like human fitness trackers, dog activity monitoring devices use accelerometers to measure physiological aspects such as activity levels, walking distance, energy expenditure, and sleep quality. They can also connect to computing applications to help users track their dogs' health and behavior over time, which can motivate caretakers to monitor their dogs' progress and adjust their behavior to improve dog welfare in the long run.

Studies show that using self-monitoring techniques either by technological interventions or by diary methods is found to be motivating for people to change their behaviors to be more active and lose weight in their daily lives (Munson & Consolvo, 2012; Wang et al., 2014; Fritz, Murphy & Zimmermann, 2014; Normand, 2008; Burke, Wang & Sewick, 2011). Moreover, data-driven feedback and information provided by these devices can also encourage people to change their behavior, as exemplified in studies with human activity trackers (Collins, Cox, Birds & Harrison, 2014; Consolvo et al., 2008; Cuttone et al., 2013; Fritz et al., 2014; Hori et al.; 2013; Kay et al., 2012; Li et al., 2011).

The use of state-of-the-art technology to support animal welfare has a dual effect. Evidence suggests that supporting dog welfare can also benefit humans, as studies show that the interaction between humans and dogs affects humans' psychological and physiological health (Beck & Katcher, 2003). Thus, animal activity monitors can contribute significantly to humans' and dogs' well-being through increased activity and time spent together and enhancing caregiving quality. In this line, investigating how monitoring technologies affect human behavior and awareness is essential, as it may reveal many intervention areas for improving humans' quality of caregiving to favor dog well-being.

3.3 Information Processing

Defining the relationship between technology and the desired human behavior/the role of technology in persuading behavior change is just one part of the equation and not enough to understand comprehensively how human behavior occurs. On the users' side, the information provided by technology first needs to be processed in human cognition. In his information processing model (Figure 3.4), Heijs (2006) posits that sensation is the starting point of user-technology interaction, in which users process the information with their sensory organs. As users are generally loaded with huge amounts of sensory information, they need to filter and synthesize it into a mental image for further mental processing, called perception. Then, in the cognitive interpretation or affective evaluation phase, this mental image is interpreted and related to emotion to initiate the actual behavior. However, between these stages, various factors, such as attitudes, habits, and intentions, may operate and influence the whole process (Heijs, 2006).

Although the behavior-steering role of technology should be taken into account during the design for behavior change, it is apparent that the internal cognitive/sensemaking processes happening on an individual level also affect behavior and decision-making processes. Thus, how people make sense of the information provided by technology should be examined to grasp technology's potential for behavior change better.

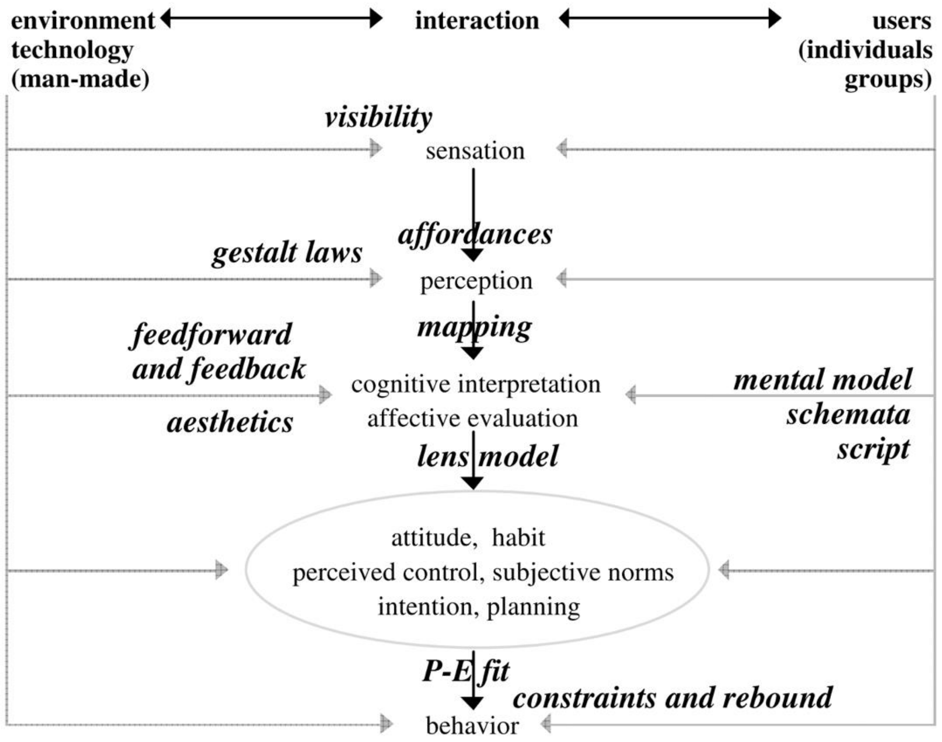


Figure 3.4. General model of information processing (Heijs, 2006, p.45).

Information processing is particularly crucial in personal informatics systems, which provide people with their self-tracking data. These systems are tools that allow individuals to track and monitor various aspects of their daily lives, such as physical activity, sleep, and nutrition, often through the use of wearable devices or mobile applications. The data provided by these systems can be extensive and complex, and the way in which users process this information is crucial in determining its impact on their behavior and lifestyle choices. Therefore, understanding the user experience with personal informatics systems is essential in designing systems that are effective in motivating behavior change. In the next section, an overview of users' experience with personal informatics systems and the models illustrating this experience are presented.

3.3.1 Reflecting on Self-Tracking Data

In the past decade, there has been growing interest in personal informatics/self-tracking systems, such as personal fitness trackers and weight and diet monitoring applications. These systems collect different kinds of personal data via their embedded sensors, such as step count, heart rate, and blood glucose levels, and provide people with health-related information of various complexity. As noted by Li et al. (2010, p.558), personal informatics systems are also known by other names; "quantified self, self-surveillance, self-tracking, and personal analytics" (Wolf, 2009; Yau & Schenide, 2009). The information gathered by personal informatics systems can be utilized for self-reflection, enabling individuals to gain a better understanding of their behavior (Carver & Scheier, 2001), make informed choices about their health and overall well-being (Endsley, 1997), and encourage behavioral changes in various areas such as health and energy conservation (DiClemente et al., 2000; Seligman & Delay, 1977). Similar to personal informatics systems for humans, dog activity monitors quantify dog behavior and provide caretakers with various health metrics of their companion animals, such as daily activity and sleep levels, energy expenditure, and rest time. However, in such systems, users are often faced with a great deal of raw data and need to process it to take action.

Personal informatics systems "help people collect personally relevant information for the purpose of self-reflection and gaining self-knowledge" (Li, Dey & Forlizzi, 2010, p.558). Li et al. (2010, p.2) define personal informatics as "an activity where people collect and reflect on personal data to understand their own behavior better". Self-reflection, on the other hand, is described as a dynamic process where people's tracking experiences constantly adapt to their ever-changing needs based on different contexts (Bentvelzen, Niess & Wozniak, 2021). However, the definition of reflection within the HCI field lacks consensus. Mols et al. (2020) define reflection as "the consideration and analysis of past, present, and future experiences to reassess our thoughts, beliefs, feelings, and actions related to everyday life" (p.68). In their comprehensive review, Bentvelzen et al. (2022) compile diverse descriptions of reflection from the available corpus. While the concept of reflection varies across definitions, it involves a dynamic and introspective process that allows individuals to reassess their experiences and make informed adjustments in their thoughts, beliefs, feelings, and actions.

Cox, Bird, and Fleck (2013, p.1) suggest that using personal informatics systems that collect self-tracking data can result in "digital epiphanies" where people reflect on their behaviors, which can lead to positive behavior or attitude changes. Personal informatics systems can facilitate accurate self-reflection by providing knowledge about behavior which might change how people perceive it, thus leading to the way to make a conscious decision to behave differently (Cox et al., 2013).

However, the reflection process on the self-tracking data does not necessarily occur the same way for everyone. Research shows that users have discrepancies in interpreting, understanding, and self-reflecting on their tracking data based on their individual differences and personalities (Bentvelzen, Niess & Wozniak, 2021). Moreover, how people make sense of this data is also influenced by various inter-connected, data-related, and lifestyle factors (Coşkun & Karahanoğlu, 2022). While collecting and making sense of data, the ultimate aim is to get meaningful insights and reflect on data to make positive changes in one's lifestyle or behaviors (Choe et al., 2014). In other words, the focus is on deriving insights from data rather than simply quantifying behavior during making sense of data. Therefore, it is crucial to understand how users make sense of information to support their self-reflection processes better and assist them in transforming personal data into useful insights for their lives (Coşkun, Karahanoğlu, 2022).

The visualization of the self-tracking data also plays an essential role in the sensemaking process as it directly affects how data is communicated to users. Therefore, it may impact how users interpret their tracking data. For instance, when people encounter the visualizations of their data on a tracking device, they undergo a complex process of sensemaking (Lupton, 2017). In this process, they need to interpret this data concerning other information, such as their past experiences, sensory information during the particular event (i.e., feelings, bodily sensations), and contextual information (i.e., their judgments about weather and environment). In these cases, people are challenged to combine different sources of information to make sense of the data and construe associations between this data and their lived experiences. Users are presented with the difficult task of interpreting visualizations of their personal data in relation to other information pertaining to their bodies and selves, which is acquired through their embodied sensations. Furthermore, they must also engage in complex data sense-making processes, which involve drawing on their prior tracking experiences, their bodily sensations at the time of the activity, and their sensory judgments of the environment (weather, traffic, etc.). In these cases, people must determine if they can trust the data produced by digital sensors associated with their bodily senses and incorporate them into their lives. This situation necessitates people to engage in ongoing conversations with the data they see on personal visualizations and the knowledge available to them through their bodies. In other words, self-tracking data requires people to go through a sensemaking process for meaningful reflection on the data (Lupton, 2017). Baumer et al. (2014) state that it is often assumed that just showing users visualizations of their tracking data for reflection via personal informatics systems will result in the reflection. However, it usually does not occur automatically, so fostering reflection on such systems is important.

Bentvelzen, Niess & Wozniak (2021) suggest that reflection is a crucial element in the use of personal informatics systems. It enables users to have positive experiences in their personal informatics journey. Users are able to adjust their tracking experience to meet their changing needs. Niess and Wozniak (2018) found that when using personal informatics systems, users often desire to achieve their qualitative goals by reaching their quantitative goals. Thus, they interpret quantitative data provided by tracking systems as higher-level notions that fit their personal goals.

Trope and Liberman (2010) proposed the Construal Level Theory (CLT), which suggests that there are two types of mental representations, namely, high construal and low construal. According to this theory, people tend to think about a situation in a more abstract way (high construal) when it is psychologically distant, and in a more concrete way (low construal) when it is closer to them. For example, one can consider walking as spending time in nature, which is more construal and abstract. On the other hand, the other can regard the same situation as walking one thousand steps, which is low construal and more concrete (Bentvelzen, Niess & Wozniak, 2021). Therefore, according to CLT, people's psychological distance determines how they make sense of different aspects of their lives, such as situations, environments, objects, and people.

Two models have been extensively discussed in the realm of personal informatics research: Li et al.'s (2010) stage-based model of Personal Informatics Systems and Epstein et al.'s (2015) update of this, the Lived Informatics Model. Li et al.'s (2010) Stage Based Model of Personal Informatics Systems (Figure 3.5) represents the experience of self-trackers with self-tracking devices, and it includes preparation, collection, integration, reflection, and action stages. According to Li et al. (2010), the two crucial components of every personal informatics system are data collection and reflection.

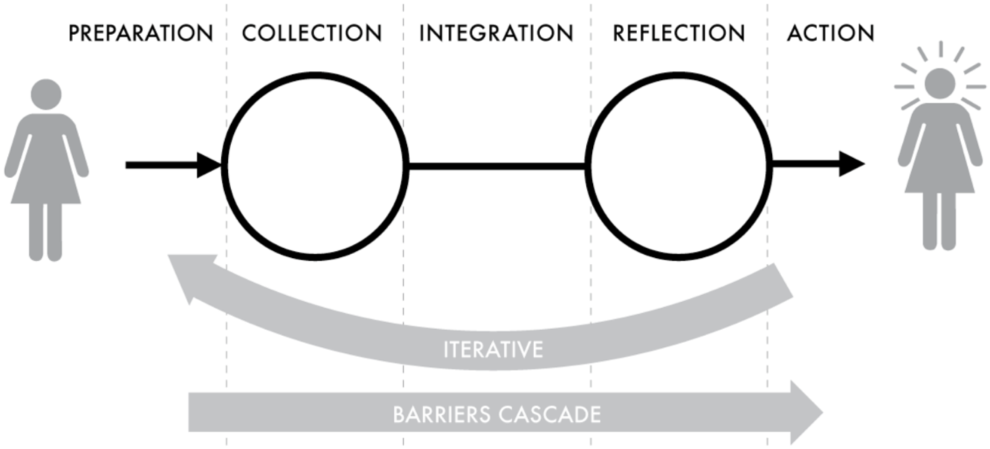


Figure 3.5. The Stage-Based Model of Personal Informatics Systems (Li et al., 2010, p.561).

Moreover, effective personal informatics systems support users in collecting the necessary personal information for insightful reflection. The Stage Based Model of Personal Informatics Systems includes five stages: Preparation, Collection, Integration, Reflection, and Action. The Preparation stage comes first and involves motivating people to track personal information and deciding what to track and how to record it. The Collection stage starts when people begin gathering data about themselves, and they may encounter various obstacles at this stage. The Integration stage lies between the Collection and Reflection stages and involves preparing, combining, and transforming the data for reflection. Reflection is when users explore and understand the data, and the Action stage involves choosing what to do with that understanding. Difficulties in these stages may arise due to a lack of time or difficulty retrieving, exploring, and understanding the collected information (Li et al., 2010).

However, the fact that most systems do not provide specific suggestions about the next step in such systems is a barrier to insightful reflection on data (Li et al., 2010). The Stage Based Model suggests that all these stages are interrelated. In other words, the extent to which people can reflect on their personal data and the effectivity/quality of self-reflection are affected by how and what data is collected

(Li et al., 2011). Focusing on the reflection stage on the Stage Based Model, in a study, Li et al. (2011) explored what kinds of questions users of self-trackers ask about their data with an aim to support the design of self-tracking tools that assist reflection. Although it is often considered that users are exposed to data offered by personal informatics systems without much questioning, it has been seen that users ask six types of questions about their personal tracking data; Status, History, Goals, Discrepancies, Context, and Factors.

Users are interested in data that reveals their current Status. They are also curious about viewing their data History, i.e., data over a range of time, rather than looking at a piece of data. Viewing long-term data allows them to see the patterns in the data and compare it from one time range with another. It is also found that patterns are especially useful for users in understanding their progress toward a goal. Users sometimes start tracking without a particular Goal. They use self-tracking to define the actions they should take to overcome an existing problem or to check whether they have a problem. Once they define their goals, they also compare their status with their goals to check for any Discrepancies. They are curious about the Context and events happening around them at the present moment to help them make sense of the changes in the self-tracking data. Users of personal informatics systems are also interested in the Factors affecting behavior in the long run, i.e., checking multiple types of data to understand their influence on behavior.

Moreover, Li et al. (2011) suggest that people's information needs change over time, and they distinguish two phases of reflection: discovery and maintenance. Users of self-tracking devices do not remain in one phase; they move between the two phases. In the discovery phase, users try to understand their objectives and the factors influencing their behavior. In contrast, during the maintenance phase, users use their collected data to stay aware of their progress towards their goals and to maintain their behavior. Users usually track only a few types of data during this phase and have already defined their objectives. They collect only enough information to assess whether they are achieving their goals. However, users may find it challenging to transition from the discovery phase to the maintenance phase when they cannot identify any actionable goals (Li et al., 2011).

Epstein et al.'s (2015) Lived Informatics Model (Figure 3.6) describes how users with varying goals integrate self-tracking systems into their everyday lives. Building upon Li et al.'s (2010) Stage Based Model, it defines the stages of deciding to track, selecting tools, tracking and acting, lapsing, and resuming during a self-informatics journey. At the deciding stage, users determine to track their personal data. It is similar to the pre-contemplation and contemplation stages of the previously mentioned Transtheoretical Model of Behavior Change. People can decide to self-track for various reasons, such as behavior change, instrumental reasons (i.e., without a defined behavior change goal, and tracking for a reward like earning discounts or badges), or purely out of curiosity. In the selection phase, people choose a tool to track. In contrast, the tracking and acting stages include the ongoing process of collecting, integrating, and reflecting on personal tracking data (Epstein et al., 2015).

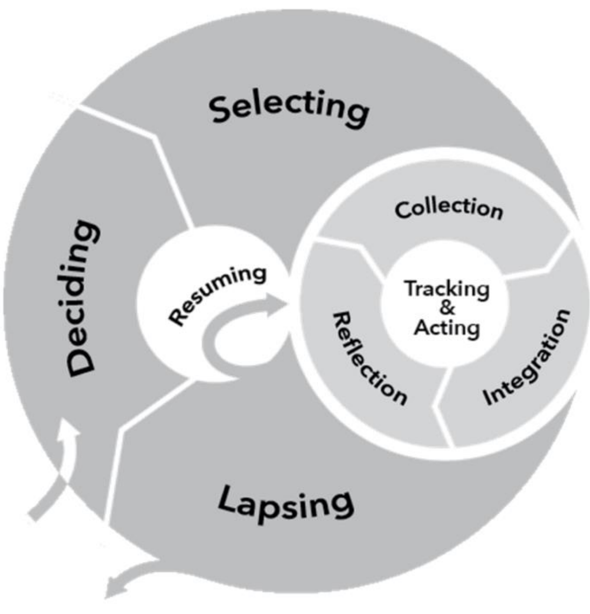


Figure 3.6. Lived Informatics Model (Epstein et al., 2015, p.5).

Epstein et al. (2015) assert that the use of self-tracking devices depends on the type of domain being tracked, such as physical activity, finances, or location. People's motivations for tracking data in each area are different, with behavior change trackers tracking data and being discouraged by inaccuracies, instrumental trackers only tracking data if the benefits outweigh the effort, and curiosity-driven trackers being intrigued by the data they find. While the stages in the Lived Informatics Model may happen concurrently and depend on data, they are included in the same stage of the model. Nevertheless, the lapsing stage begins when users cease using self-tracking tools actively. Lapsing can be caused by problems with data collection, as well as barriers to integration or reflection. Short-term lapses can be followed by a quick resumption of tracking, known as the resuming stage. In such cases, users may not reconsider their decision to track or the tool selection. However, after a long lapse, users may not necessarily resume collecting more data. Instead, they may continue integrating or reflecting on previously collected data and later decide whether more data is needed. The Lived Informatics Model implies that users' objectives for using self-tracking tools impact how they use and interact with these devices throughout their self-tracking journeys (Epstein et al., 2015).

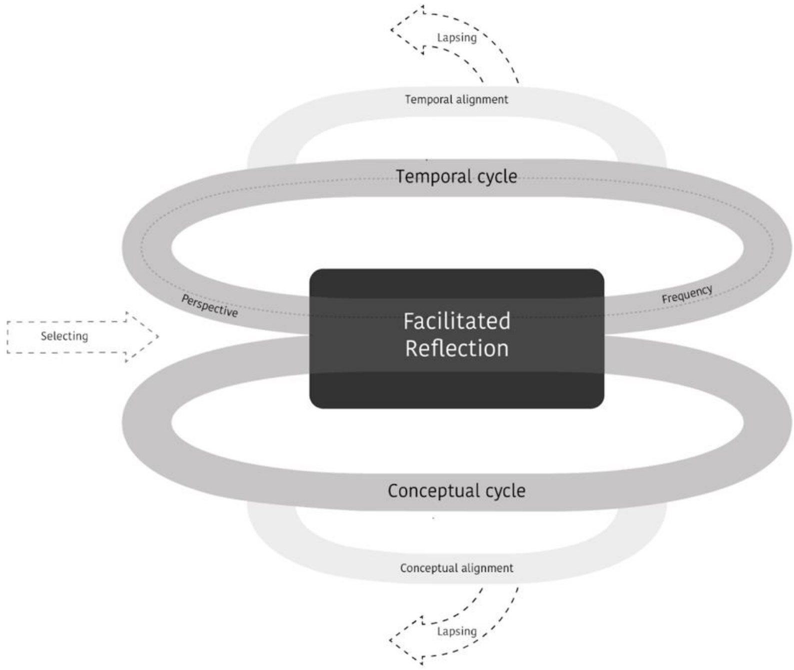


Figure 3.7. The Technology-Mediated Reflection Model (Bentvelzen, Niess & Wozniak, 2021, p.6).

Bentvelzen, Niess & Wozniak's (2021) Technology Mediated Reflection Model (TMRM) describes users' behaviors and practices in the reflection phase of their experience with personal informatics systems (how users enter, exit, and stay in the reflection phase) (Figure 3.7). It also illustrates the conditions and barriers to reflection on personal data. The process of reflection in personal informatics systems is not a fixed one but rather a constantly evolving process where users adapt their tracking experience to their changing needs. This adaptation happens in a context and often requires reframing one's needs, resulting in the need to adapt the tracking experience repeatedly. The TMRM model explains how users require different perspectives on their data, which may change over time. The model divides the reflection experience into two cycles - temporal and conceptual (Figure 3.7). The temporal and conceptual cycles in the model demonstrate how users' needs and perspectives change as they engage with the trackers. The temporal cycle highlights how users' perception of time changes in their personal informatics experience, while the conceptual cycle focuses on the levels of abstraction users use to interpret their tracking data. In this cycle, users constantly interpret data in a reflection process by relating the feedback they get from their trackers to their real-life experience.

Bentvelzen, Niess & Wozniak (2021) exemplifies the model with an amateur athlete using a fitness tracker. The athlete selects an activity tracker matching his needs, indicating a partial conceptual match between his data needs and the device's tracking capabilities. However, in time, the user needs to track more types of metrics than provided by his tracker, resulting in a conceptual mismatch. Additionally, he desires to review the personal data in a wider range of time periods than available on the tracker - temporal mismatch. Because of these mismatches, the user decides to create an Excel spreadsheet to manually enter and track additional metrics of his preference and check different periods. By doing so, he overcomes the temporal and conceptual mismatches faced during the process with the help of an additional tool (a spreadsheet). This tool allows him to re-enter the conceptual alignment phase and to stay in the facilitated reflection cycle.

Although many studies touch upon the sensemaking practices in human self-tracking systems, the literature lacks such studies for dog activity monitoring systems. As an example of the studies with location tracking systems for dogs, Mancini et al. (2012) investigated how these devices influence human behavior and change human-dog relationships within domestic settings. They also explored how humans' sensemaking of data is mediated by location-tracking technology. The study involved home visits and in-depth interviews with seventeen households in the UK where one or more people utilized location-tracking devices for their dogs. The results revealed that the participants interpreted the motion patterns depicted on the digital map by combining this information with their existing knowledge of their dogs and the territory. This allowed them to make inferences about their dogs' position and activities in a particular context. Thus, it was seen that the use of the tracking device resulted in a change in the participants' interaction with their dogs by enabling a more effective understanding between them.

Similarly, in their qualitative study, Weilenmann and Juhlin (2011) investigated how the location tracking technology allowed hunters to interpret their dogs' behaviors during the hunt and influence their interaction. The study showed that hunters construe the dogs' actions based on the positioning information provided by the GPS tracking devices. This supported hunters in getting a better understanding of the current situation during the hunt and taking action based on their interpretations of tracking data, affecting the overall hunting experience.

Zamansky et al. (2019), on the other hand, investigated the caretakers' perception of a dog activity monitor through a questionnaire with eighty-one caretakers. It was seen that the device improved caretakers' motivation to increase their dogs' activity levels by gaining insights into their everyday activity and allowing them to make judgments about their caregiving quality. With the use of the device, they were able to make inferences about what their dogs do when left alone at home, tailor the food amount based on the burned calories information, be more aware of their activity levels and make judgments about it and take action regarding their caregiving practices accordingly.

As shown by previous studies with GPS-enabled collars and dog activity trackers, the data provided by these systems and how humans make sense of this data transform how they relate to their dogs and the interactions between them. Therefore, understanding human users' sense-making practices in using dog activity monitoring systems and supporting them in making more informed caregiving decisions are crucial as it directly impacts human-dog relationships and, relatedly, dog welfare. To do so, we first need to clarify what are data, information, and knowledge and how these are processed in human cognition.

3.3.2 Data, Information, and Knowledge

Data refer to symbols that are often useless without context (Ackoff, 1989). According to the data-information-knowledge-wisdom (DIKW) pyramid, data is placed at the bottom of the “knowledge hierarchy” (Figure 3.8). It goes through a transformation in humans’ cognitive processes (Rowley, 2007). Data is first turned into information (through answering who, what, when, and how many questions), then into knowledge (answering how questions), and lastly into wisdom (answering why questions) (Ackoff, 1989). In information systems such as activity monitoring devices, people are faced with vast amounts of raw data and need to process it in their cognition to infer meaning.

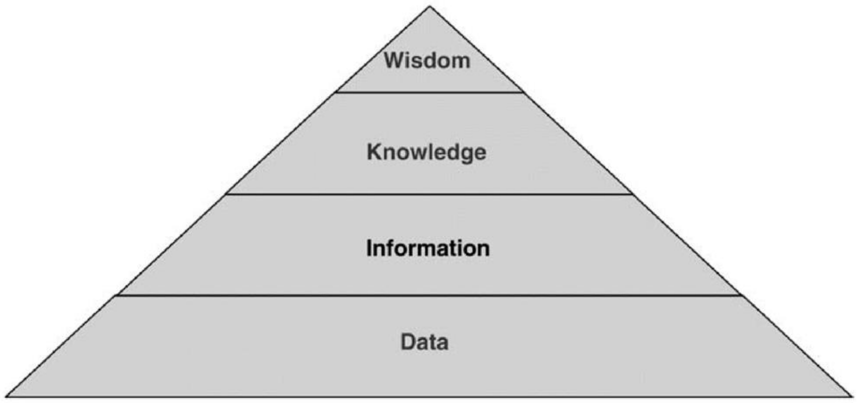


Figure 3.8. The DIKW hierarchy (Rowley, 2007, p.164).

3.3.3 Sensemaking Models and Theories

In an attempt to explain why people seek information and how they process it, various models and approaches have been developed. From an HCI perspective, Russell et al. (1993, p.269) defines sensemaking as “the process of searching for a representation and encoding data in that representation to answer task-specific questions.” Thomas et al. (1993, p. 240), on the other hand, provides a broader view and describe it as “the reciprocal interaction of information seeking, meaning ascription and action”. It includes collecting information and searching for a way to organize it into representations to achieve understanding (Pirolli & Russell, 2011). According to Russell (2003), when confronted with complex information, people first create representations in their minds to make sense of it. In order to "make sense" of certain content, people gather various bits of information and create one or more representations of it that help in organizing the content (Russell, 2003). In other words, sensemaking is the active processing of information and the creation of mental representations for comprehension. Klein et al. (2007, p. 114) define sensemaking as “the deliberate effort to understand events”. It also occurs when people are confronted with new challenges in unfamiliar contexts and their expertise is inadequate (Zhang et al., 2008). There are different perspectives and theories related to sensemaking in various domains in the literature; in Human-Computer Interaction (Russell, Stefik, Pirolli, & Card, 1993), the macro cognition approach of psychology (Klein et al., 2006a, 2006b), information and library science (Dervin, 2003; Savolainen, 2006), and organizational science (Weick, 1995). Although these approaches consider sensemaking processes in diverse fields, their common focus is to explain how people infer meaning from the data.

In the macro cognition approach of psychology, sensemaking is defined as the process of achieving a state of knowledge (Klein, Moon & Hoffman, 2006b). It is different from situation awareness, which refers to being in a state of knowledge about the environmental elements or inferences from them. According to Klein et al.’s (2006b) data/frame model of sensemaking (Figure 3.9), sensemaking is a process of framing and re-framing based on the acquired data. People make sense of events/situations through meaningful representations called “frames”. They are chunks of knowledge simplified and used to perceive things in cognitive processes. When a person encounters a new situation, an internal representation, “a frame”, is formed as an interpretation of the situation. In other words, people construct raw data as frames to prepare it for mental processing. Frames can be in various forms, such as stories, maps, diagrams, or scripts.

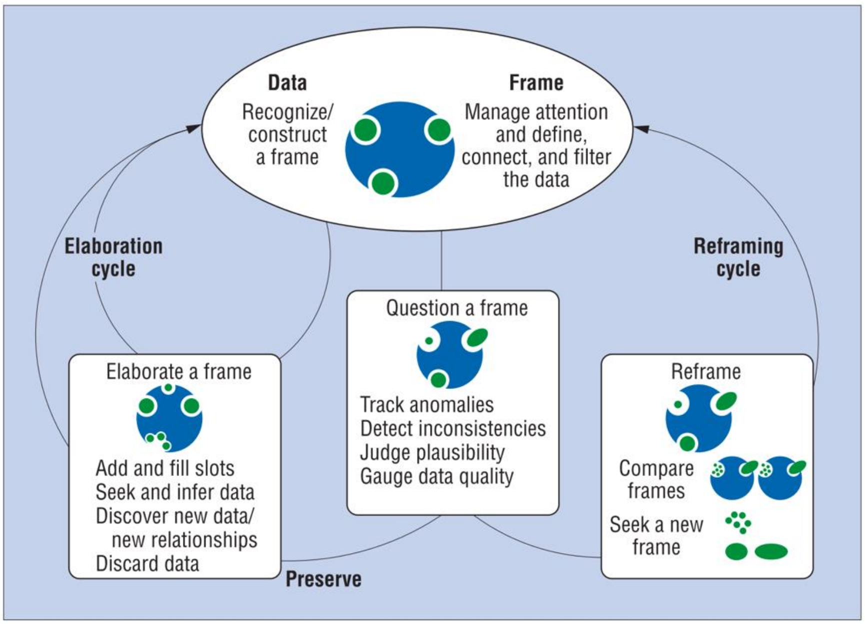


Figure 3.9. The Data/Frame Theory of Sensemaking (Klein et al., 2006, p.89).

Moreover, they go through a change as more data is acquired. Klein et al.'s data/frame model posits that sensemaking involves elaborating on a frame, questioning, and reframing it if the initial frame is rejected in the cycle. During this process, more supporting information is collected to add details to a frame and to question it by exposing any inconsistencies in the data. Frames in the sensemaking process reduce the amount of data required for comprehension, but they can also call for more data for further questioning. A frame can guide information seeking and reveal further data that might change the initial frame. In other words, a frame may operate as an information filter, influencing which details will be noticed in a situation and what information will be sought after (Attfield & Attfield, 2010).

Furthermore, according to the data/frame theory, during the sensemaking process, mental models are generated to explain past events. A mental model refers to the memory representations of past experiences and is often referred to predict how future events will unfold. Thus, the formation of mental models also affects how a person will deal with new events or information. Similar to frames, these mental models also change as more data is acquired (Klein, Moon & Hoffman, 2006a).

In Weick's organizational sensemaking approach, data and frame interact similarly to Klein et al.'s model (1995). He asserts that when groups of people make sense of new events, they go through a process in which they categorize information, filter it through retrospective attention, mental models, and narration, assign meanings to it and use it as a guide for further interpretation (Weick, Sutcliffe & Obstfeld, 2005).

On the other hand, Pirolli and Card's conceptual model (1993) (Figure 3.10) describes technology-mediated sensemaking - how people make sense of the huge amounts of data provided by computerized systems. The model shows that the overall sensemaking process that users go through consists of two major loops; foraging and sensemaking loops. The foraging loop involves seeking, filtering, reading, extracting, and placing information into a schema. On the other hand, the sensemaking loop can be explained as the iterative development of mental representations from the initially formed schema, providing a basis for understanding. In this model, raw data is first processed into representations; however, this process does not occur in a single direction. Instead, there is always an interplay between both loops. Starting from the beginning of the foraging loop, the incoming raw data is collected for later processing. Then, based on the gathered data, schematic representations are created to support interpretation. In the sensemaking loop, on the other hand, hypotheses are formed, and the schemes shaped in the previous step are reconsidered in light of the collected information. At this step, new data is extracted from the previously stored information or new data is sought if necessary. The flow in this model represents the transformation of data from its raw form into another state which enables taking action. As can be seen, the focus of sensemaking studies/models within HCI is on technology-mediated sensemaking (Russell et al., 1993; Pirolli & Card, 2005).

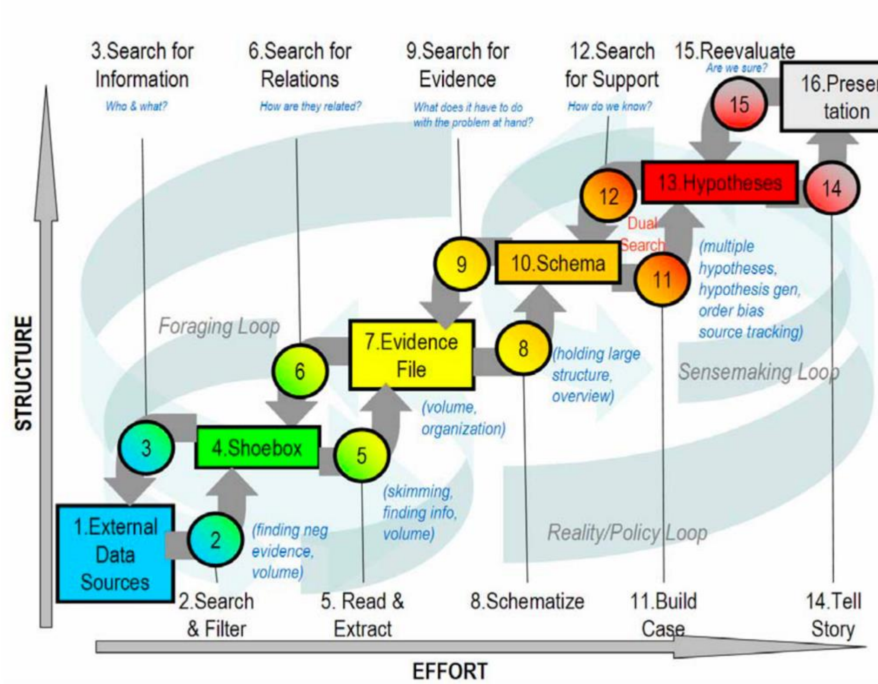


Figure 3.10. A conceptual model of sensemaking in intelligence analysis (Pirolli &Card, 2005, p.3).

On the other hand, Dervin's model of sensemaking (2003) (Figure 3.11) is concerned with individual sensemaking, underlying the cognitive gap individuals experience when attempting to make sense of the newly observed data. According to the model, when a new situation is encountered, it results in a cognitive gap. Moving from the situation to the outcome requires a bridge to be formed to fill in this gap. In other words, the gap compels the person to find a way to bridge the gap and reach an outcome. The building blocks are used to build the bridge, such as individual mindset, the person's attitudes, beliefs, feelings, and past experiences influencing her decisions. The outcome depends on how the gap is bridged, so potential outcomes are not obvious initially. Once the bridge is built, the person can reach the outcome (Dervin, 2003).

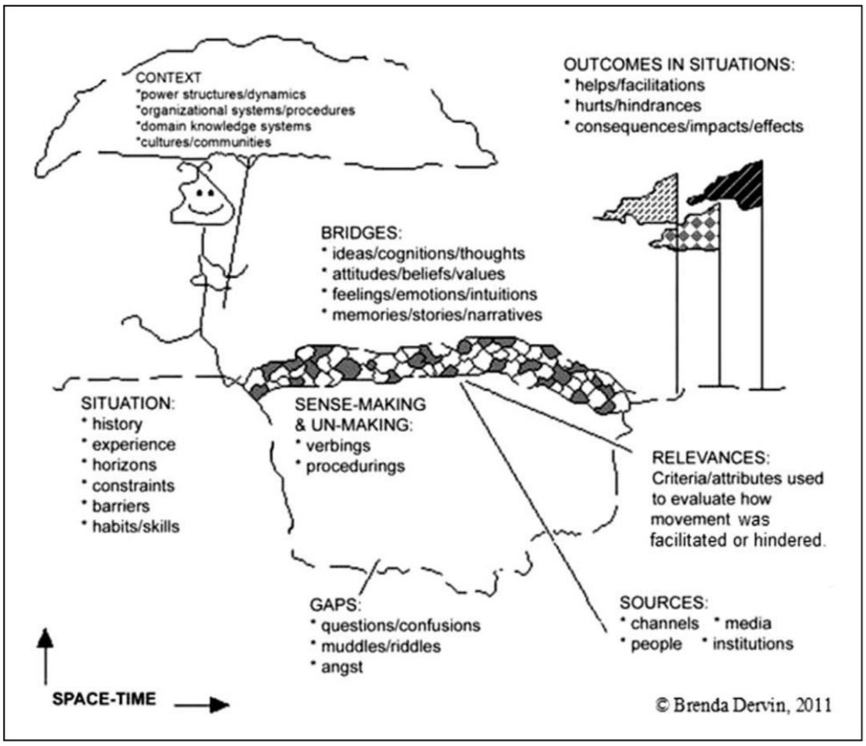


Figure 3.11. Dervin's Sense-Making Theory (Reinhard & Dervin, 2012, p.33).

Although all of the above-mentioned sensemaking models originated from different fields, they all aim to develop an understanding of how sensemaking occurs in the human mind so that better systems can be designed to support sensemaking. Thus, it can be concluded that there are many interconnected factors affecting individuals' sensemaking. Using activity monitoring systems and making sense of the data provided via these systems is a cognitively demanding task, requiring users to deal with too much information.

3.4 Conclusions Regarding the Chapter

In conclusion, this chapter has provided a comprehensive overview of existing behavior models, theories, and frameworks, along with the role of technology in behavior change. By exploring the persuasive role of technology, behavior change models, theories, and frameworks, reflection on self-tracking data and sensemaking models and theories, a deeper understanding of the cognitive mechanisms underlying human behavior and behavior change has been established. Moreover, it has shed light on the complexity of human behavior change and sensemaking processes.

The examination of the persuasive role of technology highlights the potential for technology to influence and motivate behavior change. By drawing upon various behavior change models, theories, and frameworks, this chapter demonstrates the multidimensional nature of behavior change and the diverse factors that can shape human behavior. Additionally, the review of the reflection on self-tracking data and sensemaking models and theories emphasizes the importance of individual interpretation and understanding of data in the behavior change process.

By understanding the cognitive mechanisms behind human behavior and behavior change, we can better comprehend how DAMS can be utilized to support humans' caregiving of dogs. The models, frameworks, and theories covered in this chapter provides guidance to assist in identifying ways to increase human awareness and promote positive behavior change via animal technologies. Having a clear understanding of these concepts is critical to exploring the potential of these technologies in promoting animal welfare through positive behavior change among caretakers.

Overall, this chapter serves as a critical foundation for the subsequent stages of the doctoral study, providing a comprehensive understanding of behavior change and sensemaking mechanisms and the persuasive role of technology. It constitutes the basis for the development of a theoretical model that contributes to our understanding of how dog activity monitoring systems can mediate the human-dog relationship and improve humans' caregiving practices.

CHAPTER 4

METHODOLOGY

The preceding chapters have underpinned the literature gap regarding the effect of dog activity monitoring technologies on human awareness and behavior. Therefore, there is a necessity for a more in-depth understanding of these technologies to ensure both dog and human well-being. The study within the context of this thesis aims to develop a theoretical model on how dog activity monitoring systems for companion dogs can mediate the human-dog relationship to improve humans' caregiving by examining the potential and possibilities of these technologies. For this purpose, a 6 week-long field study was conducted with 30 caretakers and their dogs, in which their experience with a particular dog activity monitoring device was investigated. This chapter explains the methodology of the study. The strategy for selecting the methods and the procedure of the study is described in detail.

4.1 Methodology Selection

4.1.1 Understanding Longitudinal User Experience

It is crucial to understand caretakers' experiences with the dog monitoring technology and the underlying thoughts, feelings, and behaviors to identify the factors that would potentially cause any change in humans' attitudes towards dogs and the human-dog relationship. However, studying a single momentary experience is generally not enough to gain insights regarding how the overall user experience is affected by using a particular design solution. Thus, gathering information about how a user interacts with a product or system changes over time is of great importance (Karapanos, Zimmerman, Forlizzi, & Martens, 2009). Therefore, it is crucial to examine the longitudinal user experience of caretakers to comprehend how dog activity monitoring technology affects their behavior, habits, and relationships with their dogs. As outlined by Günay (2017), the most prominent methods for studying long-term user experience from the UX literature are explained below.

One of the mostly adopted methods for studying longitudinal user experience is in the UX literature is cultural probes. These are qualitative research tools to gather inspirational data from people about their experiences, feelings, and ideas. Probes can include various tools such as postcards, maps, cameras, photo and media diaries, pens, stickers, and different kinds of tasks to provoke inspirational responses from the participants. They are designed specifically for certain groups of people, contexts, and environments and provided to them to self-document. This method aims to gather inspirational insights from the participants by enabling them to be actively involved in a user-centered design process. It is also a useful and effective method for overcoming specific geographic and cultural differences (Gaver et al., 1999). Cultural probes are flexible tools to elicit rich user insights that can be especially useful in remote user research. However, the assignments might be overwhelming for some participants.

Diaries are another method used to gather information from the users by having them record their thoughts and feelings related to a specific activity or experience to understand long-term user behavior. In this method, users are asked to either write down their experiences or rate them based on a given scale. There are three types of time-based reporting styles used in diaries: time-based, fixed schedules, and variable schedules. In time-based diaries, participants are asked to report their experiences at random or fixed times or a combination of these (Bolger, Angelina & Eshkol, 2003). However, in the diary method, the time interval between each report should be carefully considered, as filling out too many reports during the research process might be overwhelming for the participants. Especially having to report at random times during the day in the variable schedule method might increase the load as the reporting time is unpredictable for participants (Bolger et al., 2003).

The Day Reconstruction Method (DRM) investigates people's affective experiences at various moments throughout their everyday lives (Kahneman et al., 2004). In this method, participants are asked to recall their previous day and reconstruct it sequentially as episodes. Then, they are asked structured questions about each episode to elicit information about their daily experiences. With participants remembering the previous day, it is intended to avoid memory bias as much as possible by evoking their recent memories without disrupting their daily activities or creating a burden. Moreover, instead of the methods used for sampling experiences in real-time, this method provides a complete picture of the day rather than capturing its random parts (Kahneman et al., 2004).

UX curve, on the other hand, is a retrospective method for evaluating long-term user experience. It helps users recall their memories and report how and why their experience with a product has changed over time. It is employed to identify the reasons why user experience improves or worsens in the long run. In this method, users are given a template, including an empty two-dimensional graph with the horizontal axis representing the time and the vertical axis representing the users' experience. They are asked to draw a curve on the graph describing how their experiences with a specific product or activity have evolved, starting from the first use until the current day. They are then asked to mark the reasons for change at their approximate locations on the curve (Kujala et al., 2011). However, the method's effectiveness might be limited by memory bias as it is based on retrospective recalling of previous experiences.

Experience Sampling Method (ESM), also known as Ecological Momentary Assessment (EMA), is another longitudinal method for retrieving information about people's daily experiences, thoughts, feelings, and behaviors (Larson & Csikszentmihalyi, 2014). In this method, participants are repeatedly asked the same questions at a frequency varying from several times a day to once every two weeks. By asking the same questions, it is aimed to identify how and based on which factors user experience varies. In ESM, participants are sent a stimulus to complete a brief report on specific questions asking about their experiences as they occur in daily life

(Csikszentmihalyi, 2014). ESM provides several advantages over other longitudinal methods mentioned above, such as DRM. Firstly, as participants are asked questions about the activities as they happen, it can be more effective in eliminating memory bias. Moreover, since ESM is based on collecting real-time, in-situ information related to participants' experiences and emotional states, it provides a deeper understanding of the underlying factors related to specific actions or behaviors that cannot be identified through retrospective methods (Csikszentmihalyi & Larson, 2014).

As Blomberg, Burrell, and Guest (2002) suggest, holism is essential in understanding the different aspects of a particular activity within a larger context. It is argued that investigating an activity or experience in isolation from its context and other related activities and behaviors provides only a limited and potentially misleading understanding regarding that specific activity (Blomberg, Burrell & Guest, 2002). The study within this thesis aims to identify the dimensions to increase caretakers' awareness of their dogs via DAMS, understand how caretakers make sense of and reflect on the monitoring data provided via these devices, and ultimately reveal the potential intervention areas for the design of these technologies to increase caretakers' awareness of their dogs to support their caregiving. This particular aim necessitates gaining a thorough understanding of caretakers' actions and behaviors in their daily lives and all aspects of user experience with the used technology in the actual context. Therefore, it is decided to employ ESM as part of the methodology in the study, considering its advantages in yielding holistic, context-relevant, and real-time data related to user experience. One of the most important reasons why the ESM was selected was that it allowed studying user experiences in their natural settings in real-time and from the users' perspective. It was also seen that studies in the field of human-computer interaction (HCI) commonly use the experience sampling method (ESM) to collect in situ information over an extended period when investigating the user experience of personal informatics systems (Wulfovich et al., 2019).

As explained in Chapter 1, research studies on human wearable activity trackers are generally longitudinal, as these technologies have to be used for a certain period to be able to understand their user experience and temporal aspects thoroughly. Thus, as covered in Shin et al.'s review (2019), interviews, questionnaires, observations, and combinations of some of these commonly appear as the most employed methodologies in these studies. Besides, while setting up the methodology of the study, the UXMx tool developed by Yargın, Süner and Günay (2018) is also utilized as a guide to help with method selection.

It might also be helpful to mention here the methodology employed in the prominent examples of user research studies on personal informatics systems within the field of HCI. Considering that the primary users of dog activity monitoring technologies are humans, the studies on these technologies in ACI mostly adapt their methodologies from the UX literature. In this research study, the methodology will be set up to gain insights from human users' perspectives as the activity monitoring devices and the companion mobile applications are mainly used by them, not by dogs. Moreover, animal welfare is a multi-dimensional notion, including various aspects such as nutrition, environment, health, behavior, and mental state, as identified in the Five Domains Model (Mellor & Reid, 1994). Thus, it is not easy to assess and observe human behavior's implications on dog welfare in the short term, which is a limitation of this study. Therefore, within the context of this thesis, the focus is not on measuring dog welfare directly but on guiding human behavior in a way to improve the caregiving quality of dogs.

In the review of Kersten-van Dijk, Westerink, and Ijsselsteijn (2016), among 6,568 studies on human personal informatics systems, 24 studies are identified, meeting the selection criteria of being a peer-reviewed empirical study reporting on the insights based on monitoring data from personal informatics systems on a non-clinical population. Among these studies, seven of them fall under the category of evaluating the user experience on existing personal informatics systems. In contrast, others focus on either the assessment of a new or a current personal informatics system. As our study focuses mainly on user experience, the methodological approach of the studies, in the category of the evaluation of personal informatics systems' user experience in this review, will be briefly explained. In these studies, it is seen that they are generally longitudinal, with durations ranging from ten days to fifty-four months (Fritz, Murphy & Zimmermann, 2014; Choe, Lee & Scharaefel, 2015; Choe et al., 2014; Epstein et al., 2015; Li et al., 2011; Li et al., 2010; Rooksby et al., 2014). The ones examining the user experience of personal informatics systems adopted voluntarily by users tend to have a longer period of usage prior to the evaluation (e.g., between three months and fifty-four months of device use in the study by Fritz, Murphy & Zimmermann, 2014). The most commonly used evaluation method in these studies is interviews (Fritz, Murphy & Zimmermann, 2014; Choe, Lee & Scharaefel, 2015; Choe et al., 2014; Epstein et al., 2015; Li et al., 2011; Rooksby et al., 2014), complemented by surveys (Fritz, Murphy & Zimmermann, Choe et al., 2014; Epstein et al., 2015; Li et al., 2011; Li et al., 2010). Some included video recordings of self-tracking experience (Choe et al., 2014), behavioral observations, and log data tracking (Choe, Lee & Scharaefel, 2015). While most of these studies are qualitative, some reported quantitative behavioral changes (e.g., Choe, Lee & Scharaefel, 2015). Diary methods are also employed in some studies to evaluate users' long-term experience with personal informatics systems (Choe, Lee & Scharaefel, 2015).

As exemplified in the studies, one single method is generally insufficient to investigate the overall long-term user experience (Väänänen-Vainio-Mattila et al., 2008). As Blomberg, Burrell, and Guest (2002) suggest, triangulating different data types is required to gain a holistic understanding in ethnographic studies. Triangulation of data refers to using qualitative and quantitative methods in combination to gain deeper insights and enable better interpretation of the relations on the findings (Blomberg, Burrell & Guest, 2002). Rossman and Wilson (1994) suggest three reasons for using triangulation of data: to confirm and corroborate each data type, to elaborate and develop analysis, and to uncover unexpected or paradoxical results. Denzin (2009) further argues that combining multiple methods is necessary to obtain a more accurate and complete picture of a phenomenon, as each method reveals different angles of empirical reality. Additionally, no single method is free of rival causal factors and may not lead to completely sound outcomes. For instance, complementing demographic survey data with qualitative research can help researchers explain why specific patterns exist within a studied population (Blomberg, Burrell & Guest, 2002). Therefore, different methods should be utilized in combination to gather rich user insights in user research studies.

Denzin and Lincoln (2000) add that “triangulation, from this perspective, is not a way of obtaining a ‘true’ reading but ‘is best understood as a strategy that adds rigor, breadth, complexity, richness, and depth to any inquiry’” (as cited in Silverman, 2015, p. 292). Miles and Huberman (1994) identify three levels of integration for combining qualitative data with quantitative data. The first level is referred to as the "quantizing level," where qualitative data is transformed into numerical data by counting instances of certain words or by converting qualitative evaluations into scales or rankings. The second level is the "linkage between distinct data types," where qualitative data is compared and connected to quantitative findings. For example, this may involve comparing open-ended responses to survey questions with the numerical evaluations provided by the same respondents. The third level of integration is the "multimethod design," which involves combining different methods, both qualitative and quantitative, to explore a phenomenon in depth. This approach allows for a more comprehensive understanding of the phenomenon being studied, as the strengths and limitations of each method can be used to complement one another. In this study, the multimethod design approach is adopted for the in-depth investigation of caretakers’ experience with dog activity monitoring devices. The findings from the qualitative interviews, hypothesis testing based on the C-BARQ results, interviews, and comparison with MDORS results t-test to see the implications of device on participants’ lifestyles are used in combination.

Since the goal of the study in the context of this thesis is to develop a theoretical model of how Dog Activity Monitoring Systems for Companion Dogs can mediate the human-dog relationship to improve human caregiving, it is important to investigate caretaker diversity in relation to the use of DAMS, in order to identify the potential intervention areas for design. To this end, the next section will explain the use of user personas as a technique for representing user diversity, as well as the methods for defining and creating these personas. User personas can provide a useful tool for designing technology that takes into account the needs, preferences, and behaviors of different users, allowing for more tailored and effective interventions.

4.1.2 User Diversity and Personas

Since the primary users of dog activity trackers are humans, they are now in the position to make caregiving decisions based on the monitoring data collected and provided by these devices. Thus, how humans reflect on the tracking data directly impacts the overall well-being of another agent, this time, companion dogs. As explained in Chapter 3, how people make sense of the self-tracking data and turn it into useful insights differs based on their distinct characteristics. Therefore, different user types regarding pet activity trackers should be considered while designing such systems to assist in humans' self-reflection processes and help them make more informed decisions about their companion animals' welfare.

One technique commonly used for the design of interactive systems to represent different user types is personas. Personas are hypothetical archetypes of real users, representing them in the design process (Cooper, 2004). It is a user-centered design method (UCD) that has long been used across different domains, such as software development, healthcare, and higher education (Salminen et al., 2022). Personas combine "archetypal descriptions of user behavior patterns into representative profiles to humanize design focus, test scenarios, and aid design communication" (Martin & Hanington, 2012, p.132). They can be particularly beneficial for guiding design decisions by providing designers with a persuasive human focus throughout the design process (Martin & Hanington, 2012). Researchers and designers have utilized this method for various purposes, such as in software development to elicit user preferences and requirements necessary for designing key software components (Adlin, Jamesen & Krebs, 2001; Antle, 2006; Blomquist & Arvola, 2002) or in healthcare to address better the needs individuals or groups of people in medical care (Hendriks, Truyen & Erik Duval, 2013; Hensely-Schinkinger et al., 2015). Moreover, a study by Orji et al. (2018) shows that people's user types are strong determinants of the perceived persuasiveness of different motivational strategies for behavior change. Furthermore, personas have been particularly useful for representing diverse user groups in the design process. For example, they are used for obtaining and understanding the needs of special user groups, such as the elderly with varying levels of mobility (Högberg et al., 2008), children with autism (Millen, Cobb & Patel, 2011), and non-verbal agents such as animals (Hirskyj-Douglas, Read & Horton, 2017).

To sum up, in this study, I aim to investigate diverse user behaviors and types through interviews with dog caretakers and represent them as personas to be considered while designing dog activity monitoring systems to provide meaningful data for these user types. Apart from investigating the user diversity and user experience of DAMS, it is also crucial to measure human-dog relationships for this study to have an in-depth understanding how these systems mediate relationships between caretakers and their companion dogs. These measures can be used to explore how the use of DAMS may impact the human-dog relationship, and to identify potential areas for intervention. In addition, using standardized measures can increase the comparability of findings across different studies, and contribute to the development of a more comprehensive understanding of the human-dog relationship in relation to the use of DAMS.

4.1.3 Measuring Human-Dog Relationship

There are several methods to assess the human-animal relationship in the literature, including questionnaire-based scales, physiological measures, and behavioral observation. Although there is no generally accepted tool for measuring human-dog relationships, in this study, I focus on questionnaire-based measurement tools for their practicality in terms of investigating the existing relationship between humans and companion dogs. Methods that require obtaining physiological measures of dogs are beyond the scope of this study. In addition, techniques based on behavioral observation are also not included within the study methodology, as the interpretation of observational data requires prolonged involvement of the animal behavior expert within the study as well as the time constraints of the thesis.

Questionnaire-based scales are mainly used to collect information about companion animals from humans interacting with them. Monash Dog Owner Relationship Scale (MDORS) is one of the most popular tools to evaluate caretakers' perceived relationship with their dogs. It is a 28-item five-point Likert scale, including three subscales: Dog-Owner Interaction, Perceived Emotional Closeness, and Perceived Costs. There is no data to determine the relationship quality (such as high, medium, or low) according to MDORS scores (Calvo et al., 2016). Therefore, only scores from a particular group of human-dog pairs or scores from different time periods for the same group can be compared. High scores on any of the three MDORS subscales are likely to indicate a favorable opinion/perception of that particular subscale, regardless of whether the subscale is about the perceived costs. A high score on the Interaction Level subscale shows a higher degree of interaction, a high score on the Perceived Emotional Closeness subscale demonstrates a greater sense of emotional closeness, and a high score on the Perceived Costs subscale represents a decreased level of cost for the caretaker (Calvo et al., 2016).

The MDORS was developed based on the social exchange theory, which suggests that a relationship continues as long as the benefits of the interaction outweigh the costs (Blau, 1964; Netting, Wilsen & New, 1987). Therefore, the scale's purpose is to measure both the positive and negative aspects of owning a dog by assessing the perceived costs of the relationship and the emotional connection. It also includes a third sub-scale to identify factors that affect dog-human interactions, covering important and varied aspects of the relationship between a person and their dog (Dwyer, Bennett & Coleman, 2006).

Table 4.1. Human-dog relationship measurement tools.

Human-Animal Relationship Scale	Reference
Monash Dog Owner Relationship Scale (MDORS)	(Dwyer, Bennett & Coleman, 2006)
Pet Attachment and Life Scale (PALS)	(Cromer & Barlow, 2013)
Lexington Attachment to Pets Scale (LAPS)	(Johnson et al., 1992)
Companion Animal Bonding Scale (CABS)	(Poresky et al., 1987)
Pet Attitude Scale - Modified (PAS-M)	(Munsell et al., 2004)

There are also other assessment tools utilized to evaluate the human-companion animal relationship (Table 4.1). Pet Attachment and Life Scale (PALS), for example, was developed to assess the attachment to companion animals, the positive and negative aspects of relationships with companion animals, and the impact of companion animals on their caretakers. It consists of four factors, which measure love, regulation of emotions, personal growth, and negative implications (Cromer & Barlow, 2013). Statements are rated on a five-point Likert scale. Lexington Attachment to Pets Scale (LAPS) (Johnson et al., 1992) is another tool to measure the attachment to canines and cats. It has three subscales: general attachment, people substitution, and animal rights and welfare. On the other hand, the companion Animal Bonding Scale (CABS) (Poresky, Hendrix, Mosier & Samuelson, 1987) is explicitly developed to measure children's bonding with their companion animals. It aims to assess child-pet activities, such as the frequency of caring for and sleeping in the same room with a pet. Responses are rated on a five-point scale on CABS. Lastly, Pet Attitude Scale - Modified (PAS-M) (Munsell et al., 2004), adapted from

Templer et al. (1981), the original PAS, is a self-report scale measuring general attitudes towards companion animals. It comprises three factors: love and interaction, pets in the home, and joy of pet ownership.

However, among all of the human-companion animal relationship assessment tools mentioned above, such as the Pet Attachment and Life Scale (PALS), Lexington Attachment to Pets Scale (LAPS), and Companion Animal Bonding Scale (CABS), MDORS is the only scale that has been tested for validity and reliability (Dwyer, Bennett & Coleman, 2006). Moreover, it has been tested using an extensive and heterogeneous sample of participants for the generalizability of the results among dog carers. Furthermore, some scales, such as PALS and Lexington Attachment to Pets Scale (LAPS), claim to measure attachment to companion animals. However, Dwyer, Bennett & Coleman (2006) argue that the term ‘attachment’ used within the psychological literature (Ainsworth, 1989) is evaluated only from the human perspective on these tools. If the dog-human attachment is to be thoroughly investigated, a measure of dog attachment from the dog perspective should also be included in these assessment tools. There are several methods to measure the dog-human relationship from the viewpoint of dog attachment. For example, Ainsworth’s Strange Situation Test (SST) (Ainsworth, 1969), originally devised to assess infants’ attachment to their mothers, is adapted to explore human-dog relationships. This procedure has revealed that dogs exhibit several distinct attachment patterns towards humans, such as proximity seeking and the secure-base effect, similar to those seen in infants (Topál et al., 1998).

Another critical limitation with most of the existing scales is that they attempt to measure the human-companion animal relationship regardless of the companion animal species. However, the studies reveal that based on the companion animal’s species, human-animal relationships show different characteristics, which affect the reliability of the results obtained by these scales (Dwyer, Bennett & Coleman, 2006). Although MDORS is considered the most reliable method to assess the dog-human relationship, it has received criticism for being excessively focused on the human component of the relationship. Consequently, it may neglect essential factors pertinent to the emotional welfare of the dog (Dwyer, Bennett & Coleman, 2006). Moreover, although questionnaires are useful and cost-effective tools to assess the human-animal relationship and animals' health or behavioral traits, they have some limitations. The fact that information about an animal is obtained indirectly through a human's reporting in these questionnaires runs the risk that the carers' subjective perceptions may bias the collected data. Thus, some tools are developed for dogs' psychological measurement to avoid this subjective bias as much as possible.

The Canine Behavioral Assessment and Research Questionnaire (C-BARQ) was designed for the psychometric evaluation of dogs (Hsu & Serpell, 2003). It is a widely used tool for measuring various aspects of canine behavior (McGreevy et al., 2013; Duffy, Hsu, and Serpell, 2008). It consists of 100 questions that ask caretakers to report on their dog's response to different types of stimuli by indicating the frequency or severity of certain behaviors. The questionnaire uses a five-point scale to measure the frequency or severity of specific behaviors, with responses ranging from "never" (scored as zero) to "always" (scored as four) for frequency-based questions and "none" (scored as zero) to "serious" (scored as four) for severity-based questions. It consists of seven sections which are comprised of fourteen categories. These categories include various behaviors, such as aggressive responses to strangers, owners or other dogs, fear-related behaviors towards strangers or other dogs, separation-related behaviors, attention-seeking behaviors, trainability, chasing behaviors, excitability, touch sensitivity, and energy level. The survey assesses the dog's behavior in each of these categories, providing a numerical score for each, based on the caretaker or handler's observations.

To calculate subscale scores in C-BARQ, the average score of all questions within the subscale is calculated, with a possible range of 0-4. For all subscales except for trainability, a higher score is indicative of more desirable behavior. It is important to note that if a dog owner has not observed their dog in the described scenario for a particular question, they are instructed to mark the question as N/A rather than guessing or making assumptions about their dog's behavior. The C-BARQ has been shown consistent with veterinarians' clinical behavioral diagnosis and also to have good reliability and validity in multiple studies (Hsu & Serpell, 2003), making it a useful tool for assessing and comparing different aspects of canine behavior.

4.2 Device Selection

As this study focuses on the exploration of the potential and possibilities of dog activity monitoring technologies with an aim to develop a model of how such systems mediate human-dog relationships, it is essential to investigate users' experiences with these devices. Although several commercial activity and behavior monitoring devices targeted toward dogs currently exist on the market, within the time frame of the study, these devices were mostly not available in Turkey, where the research study was conducted. However, it was required to provide participants with these devices to investigate their long-term user experience. Therefore, the device used in the study has been selected based on the criteria mentioned below and distributed to the participants in the study.

As explained in detail in Chapter 2, the activity and behavior monitoring devices mentioned below utilize accelerometers to obtain dogs' physiological measurements, such as activity levels, walking distance, energy expenditure, and sleep quality. These are paired with a companion mobile application that can be downloaded on a smartphone. The most prominent examples of state-of-the-art dog activity and behavior monitors are listed in Figure 4.1. These are reviewed and compared based on their features, availability, suitability to varying dog sizes and breeds, and compatibility with different mobile operating systems.

Brand	Image	Attachment Type	Features	Compatibility	Mobile App	Availability
Fitbark 2		Collar	Activity, rest, distance, calorie burn, sleep and health index monitoring	Suitable for canines of all sizes and breeds	IoS & Android	Worldwide
Animo		Collar	Activity, calorie burn, sleep quality, and behavior monitoring (barking, scratching, shaking)	Suitable for canines +3.6 kg	IoS	Worldwide
Whistle Fit		Collar	Activity, rest, sleep and behavior (licking, scratching) monitoring, food portion calculator	Suitable for canines of all sizes and breeds	IoS & Android	US only
PetPace		Collar	Temperature, activity, pulse, respiration, positions, calories consumed and burned, and heart-rate variations monitoring Include monitoring service and requires subscription	Versions suitable for canines and cats +3.6 kg	IoS & Android	Not available in Turkey
Link		Collar	Activity monitoring and location tracking Include service subscription for GPS/ cellular network	Suitable for canines of all sizes and breeds	IoS & Android	US only
PetKit Fit		Collar	Movements, emotions, health conditions, short and deep sleep intervals, calorie burn	Information not available	IoS & Android	Worldwide
Voyce		Collar	Heart rhythm, Respiration, Voice, Rest quality, Distance, Calories expended, Activity and activity intensity, Light	Information not available	IoS & Android	Worldwide
Heyrex		Collar	Activity level Scratching, Sleep quality	Suitable for canines of all sizes and breeds	IoS & Android & Desktop	Not available in Turkey
Garmin Dog Tracking Products		Collar	GPS tracker and training collar (10 levels of instant and continuous stimulus or tone and vibration sending)	Suitable for dogs of all breeds and sizes	Handheld and Dog Device	Worldwide *(bound to country-based legal restrictions)*

Figure 4.1. List of available dog activity and behavior monitoring devices.

It was seen that the Animo dog behavior and activity monitor’s mobile application was not compatible with Android devices, which would be a limitation for the participant selection. Also, Whistle, PetPace, and Link smart collars were not shipped to Turkey in the study period. Thus, when the remaining two products, Fitbark 2 and PetKit Fit, were compared, it was seen that Fitbark 2 had more extensive features and fitted dogs of any size and breed. In contrast, on PetKit Fit's website, there was no information found related to the breed compatibility of the device. Fitbark had another version, Fitbark GPS, offering a GPS tracking feature; however, it was only available in the US as GPS tracking technology functions based on the cellular network provider. For this reason, it did not function in any other country than the US. Thus, Fitbark 2 was ultimately selected to be used in the study among the existing available dog activity and behavior monitoring devices.

The Fitbark activity tracker device provides caretakers with information about dogs' physiological states by monitoring their daily activity and sleep patterns. The tracker is placed on the dog's collar and then synchronized with the mobile app that runs on mobile devices with Android and iOS operating systems. It monitors dogs' activity and resting durations via a three-axis accelerometer. Connecting the app via Bluetooth or Wi-Fi, the device provides caretakers with real-time activity reports related to their dogs via the mobile application's user interface. When the device and the mobile app are connected to the Internet, the tracking data is updated hourly and allows caretakers to reach this information without having the need to be physically close to the dog. Moreover, the health informatics data collected via the device can be shared with veterinarians or trainers to better track dogs' health and behavior. The insights and findings gained through users' long-term experiences with dog activity monitors are used to investigate these technologies' effects on human-dog relationships and caregiving quality.

4.3 Participant Selection

The participants in the study were recruited according to the purposive sampling strategy, which is based on selecting information-rich cases considering specific criteria and restricted resources for in-depth studying (Patton, 1990). Moreover, maximum variation sampling was employed in participant selection among the different purposive sampling methods. As Patton (1990) suggests, maximum variation sampling represents recruiting sample individuals with quite different experiences. This strategy aims to identify the variation in the sample group and investigate any common patterns that would be of central importance for the study. In maximum variation sampling, the aim is not to make generalizations from a sample to a larger group but to identify common patterns in a varied sample (Patton, 1990). In Kersten-van Dijk, Westerink, and Ijsselsteijn's review (2016) on personal informatics systems within the field of HCI, it is seen that an average of twenty-five participants was recruited in these studies. Most of the studies began with a larger sample for a preliminary review, followed by a further selection within the initial sample for the actual research. In this research, thirty dog caretakers were enlisted as participants to ensure diversity in terms of dog age, size, breed, and length of ownership. Other demographic variables like the presence of children, marital status, age, education, and income were also considered as they have been linked to various dimensions of dog companionship by Dotson and Hyatt (2008). The purpose of this study is to identify dimensions to increase caretakers' awareness of their dogs through activity monitoring systems. Therefore, a diverse group of caretakers was included in the sample for this exploratory study.

Social media posts were shared on researchers' personal accounts for recruiting participants, including a contact form/screener survey to gather volunteers' contact information and check their dog's eligibility with the sampling criteria. The announcement was also sent to a private group that was known to include many dog caretakers. Participants were required to own a smartphone with either Android or iOS operating systems for using the activity tracking device and its companion mobile application. Also, adequate English knowledge to interact with the device and companion mobile application was another criterion for the participant selection, as the mobile application's user interface is offered only in English.

However, the form did not include questions related to these two criteria to prevent any misunderstandings. Instead, an initial screening was run on the collected information, and the volunteers who did not comply with the sampling criteria were eliminated. Besides, considering the high engagement rate of the study call, it was decided to recruit dog caretakers based in Ankara, where the researcher was located, to ease the return process of the activity monitoring devices. Based on all these criteria, the remaining volunteers were contacted via e-mail and informed that owning a smartphone and having enough English knowledge to interact with the device app was required for the study. As the field study started during the COVID-19 pandemic, it had to be conducted remotely. The study started on 17th April 2021 and was completed with the participation of 32 caretakers in total on 8th August 2022. Two participants could not complete the research process. One of them had a poor internet connection due to his location at the time, which was crucial to conduct the study remotely, and the other faced unexpected health issues during the study period. To compensate for the drop-offs, two more caretakers were recruited to reach up to 30 participants. Sample distributions for caretakers and dogs are shown in the Table 4.2 and Table 4.3.

Table 4.2. Caretaker sample distribution.

Variable	***Characteristic***	***Total Number***
Sex	Female	20
	Male	10
Age	18-25	3
	26-35	20
	36-45	5
	46-55	1
	> 55	1
Household type	Living with a partner	17
	Living with family	1
	Living with parents	4
	Living with a housemate	1
	Living alone	7
Education	Doctorate / Ph.D.	4

	Masters	9
	Bachelors	14
	High School	2
Having children	Yes	1
	No	29
Other dogs	Yes	8
	No	22

Table 4.3. Dog sample distribution.

Variable	***Characteristic***	***Total Number***
Sex	Female	20
	Male	10
Age	1-2	3
	3-4	20
	5-6	5
	7-8	1
Breed	Unknown / Mix	9
	Golden Retriever	3
	German Shepherd	2
	Other breeds	14

Figure 4.2 illustrates the structure of the methodology and how different stages of the study, including research steps for data collection, data analysis, and findings relate to each other.

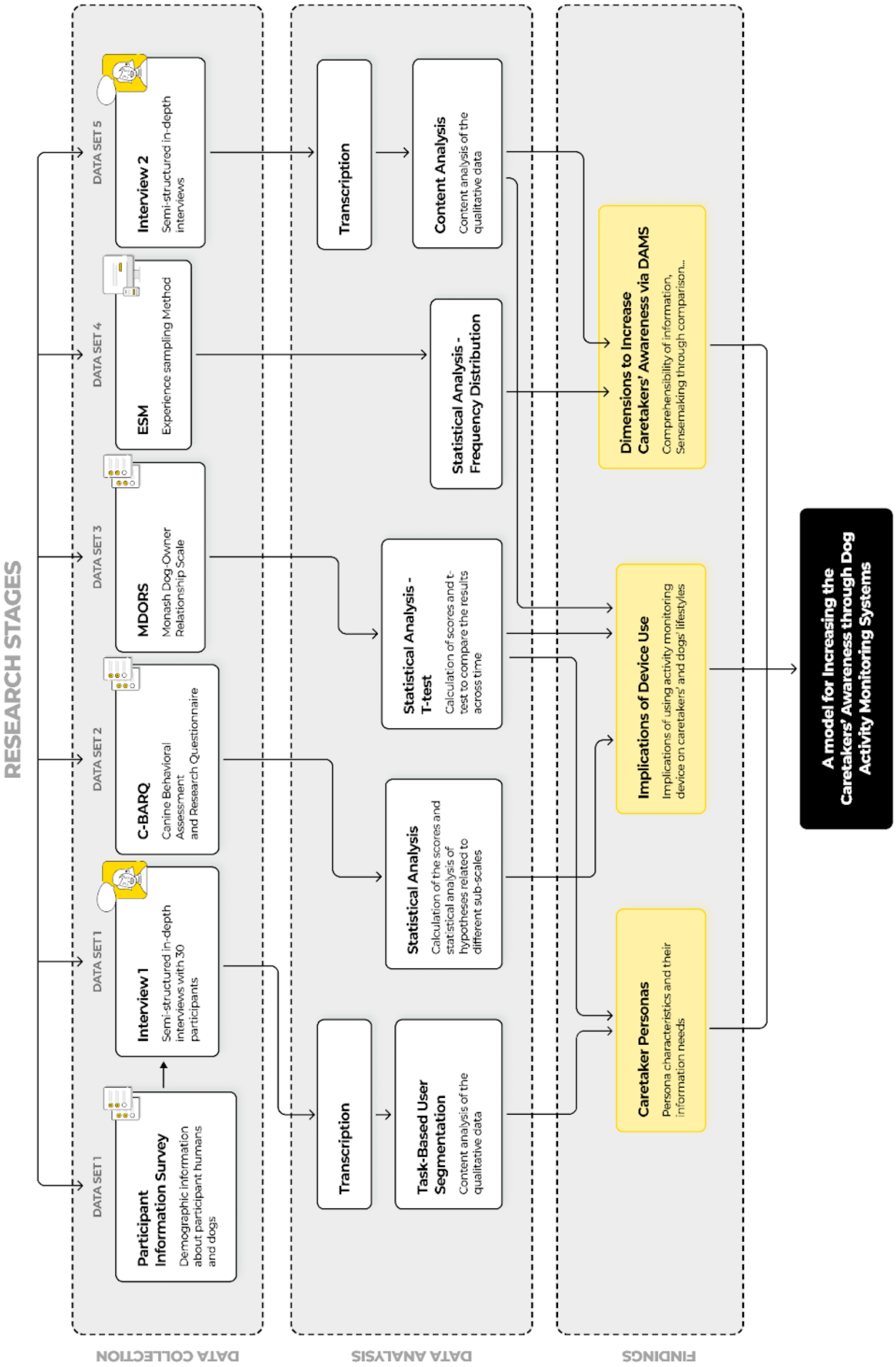


Figure 4.2. Structure of the methodology.

4.4 Research Materials

The research study explained in this paper has been approved by the Applied Ethics Research Center (protocol number: 277-ODTÜ-2019). The study is funded by Scientific Research Projects (BAP) with the project ID TEZ-D-203-2020-10260. The research materials described in this section, including the participant consent form, study procedure, and study cards can be found in Appendix A, Appendix D, Appendix G respectively.

As the study could not be conducted face-to-face due to the ongoing COVID-19 restrictions, all research materials, including printed out study cards, and FitBark dog activity monitors were packed and shipped to the participants as a research kit (Figure 4.4). The study cards include an instruction card, a wish card, a video task card, and a process card (Figure 4.3) (see Appendix G). The instruction card is designed to briefly introduce participants to the monitoring device, the features of the companion mobile application, and how to use them. The wish card includes the following questions for participants to answer and a note-taking area;

- What would you most like to know about your dog? Why?
- If your dog could talk, what would you ask her? (i.e., her feelings, thoughts, needs and preferences) Why?

These questions are intended to provoke ideas in participants and encourage them to think about their relationship with their dogs from a different perspective. In the video task, participants are asked to record a short video of their dogs at a moment when they think their dog is happy, sad, angry, or frustrated and share it via WhatsApp or Email. This task is designed to see how participants interpreted their dogs' emotions or behaviors. Lastly, a study information card is included to inform participants about the study procedure with a brief explanation and the duration of each phase of the study.

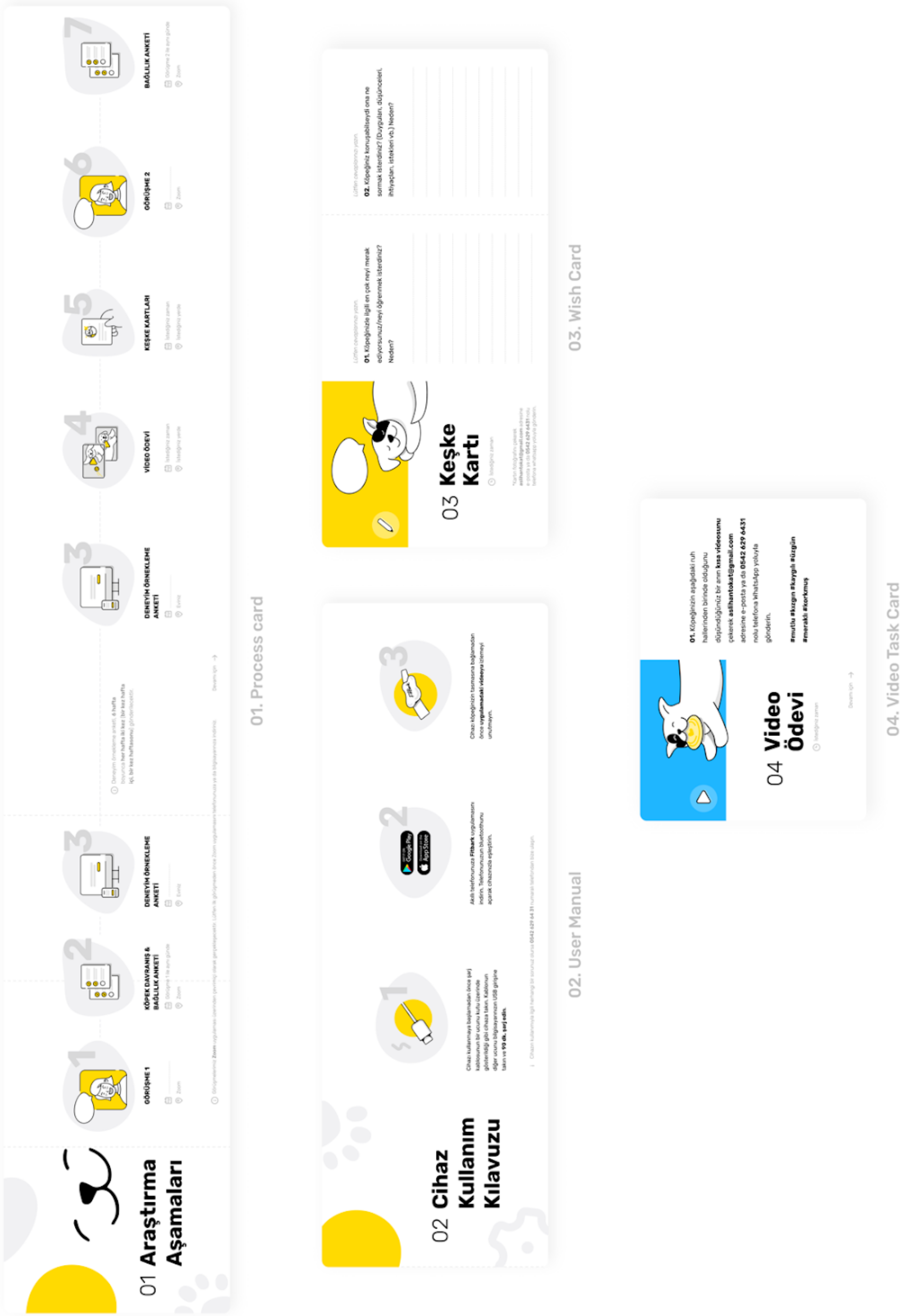


Figure 4.3. Study cards.

Figure 4.4. Research kit.

4.5 Procedure of the Study

As explained in Section 4.1.1, measuring long-term user experience is important for holistically comprehending the actual user experience. Therefore, to understand the user experience thoroughly, the field study is designed as a longitudinal study consisting of three main stages: pre-usage, usage, and post-usage.

In the study, in-depth semi-structured interviews are complemented with the experience sampling method (ESM), online questionnaires, and measurement tools to retrieve deeper information from the participants. Before starting the study, a pilot study was conducted to test the proposed research methodology and see whether the collected data answered the research questions. Based on the results of the pilot study, the study setup was finalized. The content of the MDORS and CBARQ questionnaires can be found in Appendix F, and interview questions in Appendix D.

The field study, which started on 17th April 2021, was completed with the participation of 32 caretakers in total on 8th August 2022. Two participants were unable to complete the research process. One had poor internet connection due to living in a rural area, and the other experienced unexpected health issues. Consequently, two additional caretakers were recruited, bringing the total number of participants to 30. All interview sessions were conducted online due to the ongoing COVID-19 restrictions.

4.5.1 Pre-Usage Stage

At the beginning of the study, participants are informed about the aim and the procedure of the study. They are asked to read and check an online consent form to confirm their participation in the study. Then, they were asked to fill in an online participant information questionnaire to collect the initial information about them and their dogs. The participant information questionnaire consisted of three parts. The first part was for retrieving participants' demographic information such as contact info, age, occupation, academic degree, and number in household. The second part included questions related to dogs, such as name, age, sex, breed, health issues, and caretaker behavior regarding play, exercise, feeding, and veterinary care. The last part included pictorial questions to understand whether or not a dog shows severe signs of stress. This questionnaire was provided to the participants before the first interview so that the prominent answers could be questioned in the latter stage (see Appendix B).

Following gathering responses to the participant information questionnaire, I conducted in-depth semi-structured interviews to understand the relationship between caretakers and their companion dogs, their lifestyles, and their caregiving habits. In this interview, I asked participants questions about their motivation for dog adoption, daily routines, primary care and grooming practices, activity and feeding habits, and current concerns and needs related to dog care. The interview provided rich data for the formation of caretaker personas. It revealed a pattern regarding caretakers' existing habits, behaviors, and concerns related to their dogs and caregiving practices. Before identifying the factors affecting human-dog relationships through the use of the dog activity monitor, it was essential to understand this relationship's current state. Therefore, following the interview, the relationship between dogs and carers was evaluated using the Monash dog-owner relationship scale (MDORS). Participants are also asked to fill in an online version of the C-BARQ questionnaire to gain insights regarding the behavior of the dogs from their perspective. Since the study was conducted with participants whose native language was Turkish, the questionnaires used in the study were originally in English and translated into Turkish. After this process, the "translation and back-translation" or "reverse translation" (Bojko, Buttimer, & Zace, 2009) procedure was conducted: the questionnaires in Turkish were translated back into English by another independent translator, and the back-translation was compared with the original questionnaire to maintain accuracy. At the end of the pre-usage stage, participants were asked to use the FitBark dog activity monitor for six weeks.

4.5.2 Usage Stage

In the usage stage, participants were asked to use the device for six weeks so that the effects of device use on dogs' and caretakers' lifestyles, existing caregiving practices, and how carers make sense of the tracking data could be identified. In this phase, the experience sampling method (ESM) was used to collect data about participants' experiences in real-time during the study (see Appendix C). Participants were asked the same questions through an online form twice a week for six weeks. The form is sent once on a weekday and once on the weekend, considering that participants' daily routines might change between these periods of the week. The survey mainly consisted of questions investigating the most used features of the mobile app and whether there are any changes in participants' and dogs' daily life based on the information provided by the app. They are reminded periodically via a selected medium, such as WhatsApp, to fill in the short survey and to use the device.

The objective was to identify the factors that influenced changes in the human-dog relationship and daily habits by analyzing the responses collected.

During this period, participants were also reminded to complete the video task and fill in the wish cards. Lastly, since the questions on the wish cards were asked to the participants in the first interview to provoke ideas, filling in wish cards was not obligatory. However, they were encouraged to note down their thoughts.

4.5.3 Post-Usage Stage

After the usage stage, a semi-structured interview was carried out to assess the entire user experience with the device and mobile app, and examine the findings obtained through the ESM forms for six weeks. In this interview, participants were asked in-depth questions about their overall experience with the device and its impact on their daily life with their dogs. Lastly, to gain more insight into the effects of using the activity tracker and the companion mobile app on the human-dog relationship, participants completed the MDORS dog-owner relationship questionnaire again.

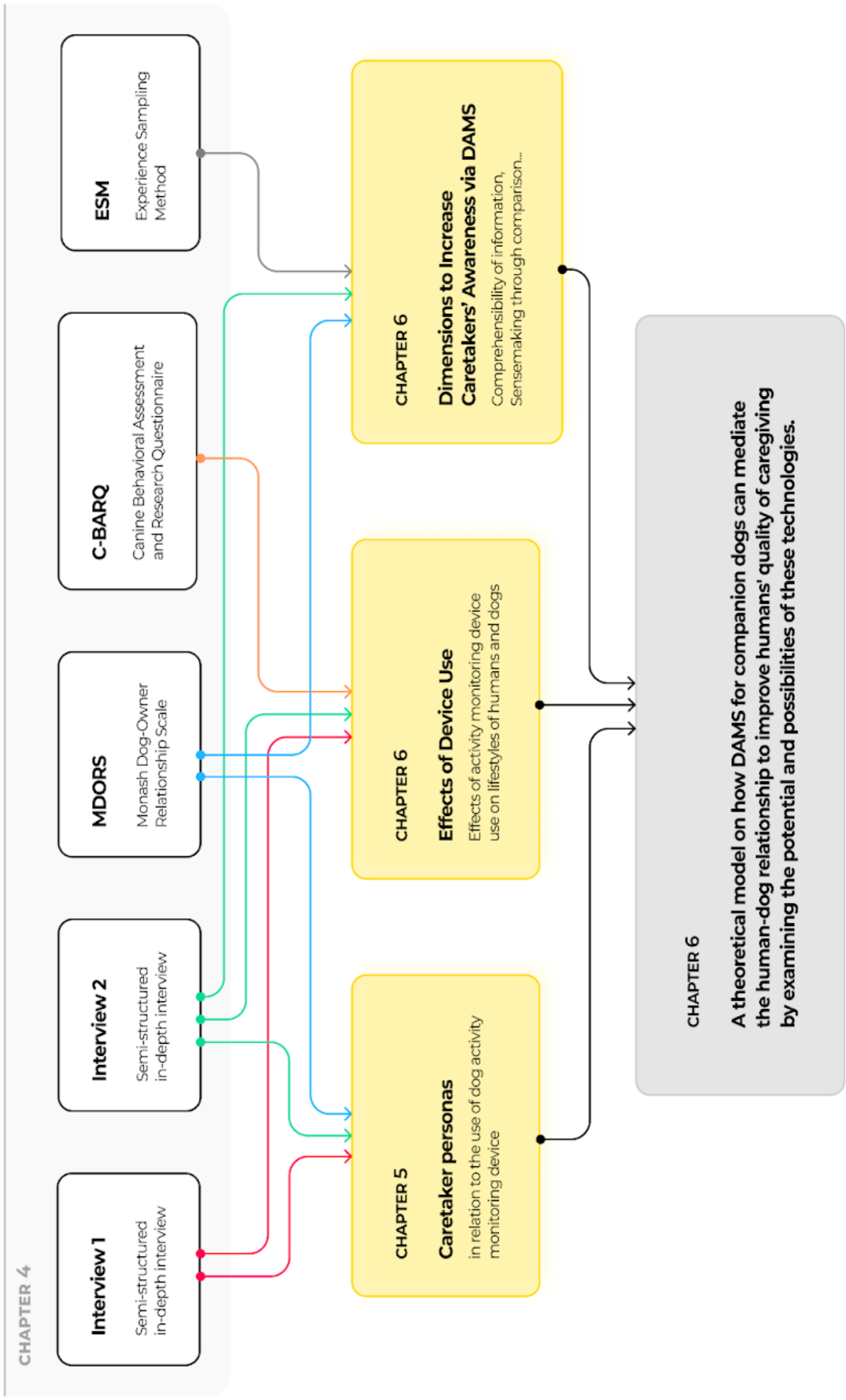


Figure 4.5. Research outcomes.

4.6 Data Analysis

This section presents the procedure followed for the data analysis process in the study. Figure 4.5 shows the key findings of the study and the data that constitute the basis of the findings. The first interview, together with MDORS and C-BARQ results, has led to the formation of caretaker personas, while the data from the second interview and the ESM formed the basis for the identification of dimensions to increase caretakers' awareness via DAMS. In this section, first the data preparation process and the theoretical background for qualitative data analysis is explained. Then, the data analysis process followed for the creation of caretaker personas and the dimensions to increase caretakers' awareness via DAMS are presented separately.

4.6.1 Data Preparation and the Theoretical Background for Qualitative Data Analysis

Before starting the analysis process, the interview data were transcribed verbatim, and transferred to the Airtable platform. This data is then analyzed to identify caretaker personas and the dimensions to increase caretakers' awareness via DAMS. Content analysis and the Grounded Theory approaches were adopted for the qualitative data analysis. Grounded Theory, developed by Glaser and Strauss (1967), is a qualitative research methodology that is used to generate theory from data. It is based on the systematic collection and analysis of data, with the aim of generating a theory that explains the phenomenon under study. In other words, rather than starting with an existing theoretical framework or concept prior to the study to see how it applies to the collected data, Grounded Theory begins with the collection of data. It involves an iterative process of coding, categorizing, and theorizing data to uncover the underlying structure of a phenomenon. In this process, specific codes are assigned to the repeating statements within the data.

Then these codes are reviewed several times to identify the emerging categories (Glaser & Strauss 1967). In other words, in Grounded Theory, data itself guides the analysis leading to the discovery of codes during the process, rather than starting with a set of predefined codes, hypotheses, or preconceptions. Grounded Theory is used to create hypotheses and to develop theories that explain observed phenomena. After collecting data and re-examining it multiple times, codes are grouped into concepts and categories, providing the foundation for a new theory. This theory is based on the gathered data (Glaser & Strauss, 1967; Corbin & Strauss, 2015).

Content analysis is also a method used to systematically analyze large volumes of qualitative data and achieve valid and replicable interpretations of it (Krippendorff, 2004). Krippendorff (2004, p.18) defines content analysis as "a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use". It is a systematic process of analyzing huge amounts of qualitative data by systematically coding and categorizing it in order to draw inferences about the meanings conveyed in the data. The approach adopted during the content analysis can be either deductive or inductive (Kuckartz, 2002). In the deductive approach, predetermined categories are used to code and analyze data. This approach relies on existing categories and theories to make sense of the data. Whereas the inductive approach does not rely on predetermined categories but instead allows for the identification of patterns and categories through the analysis of the data, allowing for the emergence of new categories or themes that may not be obvious in the first place (Kuckartz, 2002).

The transcribed raw qualitative data from both interviews were analyzed using grounded theory and content analysis with an inductive approach. The raw data were first read through and divided into smaller and more meaningful chunks. They were then assigned initial codes based on emerging patterns in the data. Following this preliminary coding process, higher-level codes or themes were assigned to the codes by identifying the recurring patterns. Lastly, participants' statements were assigned the final codes and sub-codes, and a codebook was created to ensure consistency and reliability in the analysis. These themes revealed the impact of dog activity monitor use on lifestyle, awareness, and sensemaking/reflection-related dimensions along with related system qualities. The coding process was iterative and cyclical, and the codes identified were reviewed several times by revisiting the research questions. The coding structure on Airtable was also created with these research questions in mind, including the columns of themes, sub-themes, product/part features, product specifications, and insights (Table 4.4). At the end of the content analysis 703 statements from the first interview and 1016 statements and 31 themes from the second interview were retrieved in total.

Table 4.4. Coding example from the second interview.

ID	I1/ 12	#	Statements	Theme	Sub-theme	Product part / feature	Senti ment
P4	I2	1	It was nice that the phone doesn't have to be near my dog all the time. After coming home, the phone can connect and synchronize with the device. It keeps track of how far he run. I especially liked that, I mean, I don't have to go on every walk with my phone and still track our progress and compare it to previous days. It was good in that respect.	Data history / Tracking trends in the data	Usefulness of storing the data history to track progress	Data Storage	+
P4	I2	2	When I walk about seven kilometers, my dog runs twenty kilometers. I have understood this. I have set something like that in my mind for the future.	Sensemaking through comparison	Making sense of the dog's tracking activity data through comparing it to one's own	Distance	~
P4	I2	3	Calories, I guess I didn't understand calories very well. I mean, it says how many calories it burns, but I don't know how many calories my dog should burn. I mean, since his goal was not there, it was not very useful for me. You know, how long should an animal that scores eleven thousand points a day sleep? I mean, how many calories does this animal need to take in a day? How much it needs to sleep and how much it needs to eat, so it would be good to give us this information.	Guidance for reflection	Need for guidance about the average levels / normals of similar dogs	Sleep quality Calories burned	~
P4	I2	4	What I don't like about it is that, when it says that your dog seventy-nine percent slept or eighty-nine percent slept today, what does that show us? I mean, what percentage does that thing need to be? It doesn't show the duration he needs to sleep or the calories he needs.	Comprehensibility of information	Difficulty in understanding what the data indicates	Sleep quality	-

Analyst triangulation was used to ensure the trustworthiness of the analysis. The goal of analyst triangulation is to reduce bias by using several analysts as opposed to only one (Patton, 2014; Denzin, 1978). For doing so, two researchers independently analyzed the %10 of the data of both interviews. Analysis was repeated by discussing and resolving any disagreement on the codes. The coding procedure was completed by one researcher based on the agreed codes.

4.6.2 Data Analysis to Identify Caretaker Personas

This section explains the qualitative and qualitative analysis processes used for the identification of caretaker personas. First, the qualitative data analysis for the first interview and how personas are created based on this analysis is described. Then, the quantitative analysis process for the MDORS and C-BARQ results is presented.

4.6.2.1 Qualitative Analysis

The data gathered through the first interview has primarily led to the formation of caretaker personas. Interview data has also been supported by the data from the participant information questionnaire.

A task-based user segmentation approach was adopted for the creation of personas. In this approach, behaviors are categorized based on the tasks performed by the users, as opposed to classical user segmentation techniques such as demographic segmentation (Young, 2008). This approach aims not to represent the target audience as an individual person but to identify essential user segments based on the common tasks they carry out to reach a particular goal.

By adopting Grounded Theory and content analysis approaches, the important behaviors and concerns of participants identified in the data were highlighted and nested under related groups: hygiene habits, time limitation, tracking, feeding habits, social life, information seeking, monitoring habits, activity habits, healthcare habits, play habits, and daily schedule. Then, these groups of behaviors and concerns were repeatedly reviewed and reorganized to identify participants' caregiving habits and practices better. After a few times of reviewing and regrouping, a matrix was created to find and highlight the patterns of codes for each participant. Following this step, eight personas were identified based on the emerging patterns. Lastly, these codes were grouped under the related personas, and the weight of personas for each participant was based on the percentage of these codes to pinpoint the persona they belonged to. By doing so, each participant was assigned to their persona.

Analyst triangulation is used to ensure the trustworthiness of the analysis. The goal of analyst triangulation is to reduce bias by using several analysts as opposed to only one (Patton, 2014; Denzin, 1978). To do so, I and the thesis supervisor independently analyzed the %10 of the data. Analysis was repeated by discussing and resolving any disagreement on the codes. The coding procedure was completed by me based on the agreed codes.

4.6.3 Quantitative Analysis

4.6.3.1.1 MDORS Score Calculation & T-Test

The scores of MDORS questionnaires, which were applied prior to and after the usage period, were calculated as the total score and for all three sub-scales separately. A paired samples t-test was applied to compare the pre-test and post-test scores (questionnaires applied at the beginning and the end of the study) to see whether there was any statistically significant difference in the perceived state of the dog-caretaker relationship within the study period (Figure). The output shows that the pre-test mean is ($M=93.76$), and the post-test mean is ($M=93.73$). The average difference between the paired pre-test and post-test scores is ($t=-0.03$). Since the p-value of 0.971 for the paired samples t-test is greater than the standard significance level of 0.05, the mean of the paired differences in the population is zero. The data support the notion that there is no statistically significant difference between the means of the pre-test and post-test scores - the mean of the paired differences is zero.

4.6.3.1.2 C-BARQ Score Calculation

The C-BARQ questionnaire included 100 questions in seven sections, and fourteen sub-scales rated on a five-point Likert scale (0-4). The average of section scores and all questions were calculated. The scores of the sections and sub-scales related to the hypotheses were included in the analysis (one-way ANOVA tests).

Following the identification of eight caretaker personas through the qualitative data analysis, the relation between personas, MDORS results, and its subscale results have been analyzed on SPSS by using One-Way Between-Subjects ANOVA. Only the pre-test MDORS scores were included in the persona analysis. The main dependent variable of the study was MDORS, based on the idea that the persona types created may directly affect the dog-owner relationship.

In addition, it was also investigated whether there was any relationship between the C-BARQ results and the personas. For doing so, the co-supervisor of the thesis study and a dog behavior expert (Assoc. Prof. Dr. Yasemin Salgırlı Demirbaş) formulated a number of hypotheses based on the persona types and the potentially related sub-sections of C-BARQ. Then, the C-BARQ scores of participant dogs for each related sub-section were gathered and tested all for these hypotheses by using One-Way Between-Subjects ANOVA on SPSS to see whether there was any statistically significant relationship between the results.

4.6.3.2 Data Analysis to Identify the Dimensions to Increase Humans' Awareness via DAMS

The data from the second interview was analyzed to identify the dimensions to increase caregivers' awareness of dog activity monitoring systems to improve their caregiving. The analysis began with the verbatim transcription of the second interview data, which was videotaped. As there were 32 participants, a total of 30 interviews were transcribed and transferred to the Airtable platform for analysis, taking into account that 2 participants dropped out during the process. Grounded Theory and content analysis underpinned the qualitative analysis of this raw data.

CHAPTER 5

CARETAKER PERSONAS RELATED TO THE USE OF DAMS

This chapter presents the key findings of the study regarding the caretaker personas related to the use of dog activity monitoring systems identified based on the analyses conducted. First, the caretaker personas and their characteristics are identified and explained in detail. Then, the relationship between the personas, C-BARQ, and MDORS scores is revealed through quantitative analysis. Finally, the implications of the findings for the design of dog activity monitoring systems are discussed.

5.1 Exploring User Diversity

As discussed in detail in Chapters 1 and 2, dog welfare and human behavior are closely related. Given the potential of technology to promote positive behavior change through the information and feedback it provides, dog activity monitoring systems appear to be a promising way to increase human awareness of the health and behavior of companion dogs. However, when designing interventions to improve the quality of human care for companion dogs through technology targeted at them, it is important to understand the characteristics of the target users clearly and to consider their diversity.

As the primary users of dog activity trackers are humans, their caregiving decisions are based on the monitoring data collected and provided by these devices. Thus, how humans reflect on this data directly impacts the overall well-being of their companion dogs. In Chapter 3, how people make sense of their self-tracking data and turn it into useful insights is explained. This process differs depending on various factors, including users' personalities, individual differences, and data-related and lifestyle factors. Moreover, it is proven that users have differences in interpreting and reflecting on their personal tracking data. The main goal of collecting and interpreting data is to reflect upon it, extract meaningful insights, and make positive changes. Therefore, different user types regarding pet activity trackers should be considered while designing such systems to assist in humans' self-reflection processes and help them make more informed decisions about their companion animals' welfare.

A study by Orji et al. (2018) shows that user types are strong determinants of the perceived persuasiveness of different motivational strategies for human behavior change. Personas are commonly applied tools by designers and researchers to represent the characteristics of these distinct user types in the design process. They are detailed and captivating depictions of hypothetical users that represent diverse segments of actual users (Adlin & Pruitt, 2010). In other words, personas combine "archetypal descriptions of user behavior patterns into representative profiles to humanize design focus, test scenarios, and aid design communication" (Martin & Hanington, 2012, p.132). They can be particularly beneficial for guiding design decisions by providing designers with a persuasive human focus throughout the design process (Jansen et al., 2017). Therefore, it is critical to identify user personas in relation to the use of dog activity monitoring systems to develop better systems that cater to diverse user needs, ultimately supporting the users in their caregiving of dogs. The literature lacks studies investigating user types and characteristics concerning dog activity monitoring systems. Thus, this section describes the development of personas for dog caretakers regarding the use of dog activity monitoring systems. It identifies eight user types to be considered when designing such systems.

The following section explains diverse user behaviors and types investigated through interviews with dog caretakers in detail. Then, the caretaker personas generated based on the study findings to be considered while designing dog activity monitoring systems - and how to provide meaningful data for these user types - are presented. Lastly, the implications of these findings on the design of dog activity tracking technologies are discussed.

5.2 Caretaker Personas

The formation of caretaker personas was primarily led by the data gathered through the first interview, as shown in Figure 4.3 in Chapter 4. The participant information questionnaire data also supported the interview data.

As explained in detail in Chapter 4, content analysis and task-based user segmentation approaches were adopted for qualitative data analysis. The following steps were taken during this process;

1. Initially, important behaviors and concerns of participants were identified in the data.
2. These were then organized into related groups: hygiene habits, time limitation, tracking, feeding habits, social life, information seeking, monitoring habits, activity habits, healthcare habits, play habits, and daily schedule.
3. These groups were repeatedly reviewed and reorganized better to understand the caregiving habits and practices of the participants.
4. The data was iteratively coded based on the patterns of caretaker behaviors and concerns identified in the first step.
5. During this process, the codes were refined.
6. Based on the emerging patterns within the codes, personas were created.
7. After several rounds of reviewing and regrouping, the identified codes and personas were placed on a matrix, and the repetition of codes was marked for each participant.
8. Following this step, eight personas were identified based on emerging patterns, namely, *attentive health guards, compassionate parents, complainers, indifferents, info geeks, physical activity supporters, responsible caretakers,* and *social butterflies*.

Table 5.1 shows the matrix in which code frequencies were marked for each participant. To calculate the weight of personas for each participant, I divided the number of codes marked for them by the total number of codes under a persona type. It is important to note that some caretakers exhibit characteristics of more than one persona type, and in some cases, the code frequencies determining their eventual persona are quite close to each other, as seen in the persona distribution table. However, I used these weights to determine each participant's persona based on the maximum value within the range of personas (as shown in the Table 5.2). Thus, I assigned each participant to their respective persona using this method (also indicated in the Table 5.2).

Table 5.1. An example section from the task-based user segmentation matrix.

Personas	Primary Behaviors & Concerns	Participants																													
		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P23	P24	P25	P26	P27	P28	P29	P30
	Attentive Health Guards COUNT	0.00	0.18	0.09	0.00	0.09	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.09	0.00	0.09	0.09	0.09	0.18	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.09	0.00	0.00
Attentive Health Guards	Trying out alternative treatment methods in case of health issues as complementary to medical treatment		x																												
	Observing the dog's health and behaviors closely in case of an health problem			x																											
	Need to monitor the changes in dog's digestive issues to pinpoint the affecting factors					x																									
	(A constant) effort to make the dog lose weight due to concerns over any potential health problem / to prevent any health problems in the future						x								x				x												
	Decreasing the amount of food to prevent the dog gaining weight						x																								
	Increased concerns over the dog's health due to medical history/past trauma		x												x						x					x					
	Being concerned about meeting the dog's activity needs due to him having low energy levels						x									x															
	Adapting certain daily / household practices acc to dog's allergic reaction to chemicals																	x													
	Need to learn about the dog's calorie intake and activity needs as to being inclined to gain weight																			x											
	Difficulty in determining the right amount of feeding acc to variables such as activity level, climate - especially not to trigger dog's digestive issues																				x										
	Concerns over the dog's habit of eating unwanted things outside														x														x		

Table 5.2. Participant persona distribution based on the code repetition.

ID	Attentive Health Guards [1]	Compassionate Parents [2]	Complainers [3]	Indifferents [4]	Info Geeks [5]	Physical Activity Supporters [6]	Responsible Caretakers [7]	Social Butterflies [8]	PERSONA
P1	0,00	0,11	0,17	0,00	0,10	0,11	0,11	0,00	**3**
P2	0,18	0,11	0,00	0,00	0,10	0,00	0,11	0,00	**1**
P3	0,09	0,11	0,00	0,00	0,30	0,00	0,11	0,00	**5**
P4	0,00	0,00	0,33	0,00	0,10	0,22	0,11	0,00	**3**
P5	0,09	0,00	0,17	0,20	0,00	0,00	0,11	0,09	**4**
P6	0,27	0,00	0,00	0,00	0,00	0,00	0,22	0,00	**1**
P7	0,00	0,00	0,00	0,00	0,10	0,00	0,11	0,00	**7**
P8	0,00	0,00	0,00	0,00	0,10	0,00	0,33	0,09	**7**
P9	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,18	**8**
P10	0,00	0,00	0,00	0,30	0,00	0,00	0,00	0,00	**4**
P11	0,00	0,11	0,00	0,10	0,00	0,00	0,00	0,00	**2**
P12	0,00	0,00	0,17	0,00	0,00	0,22	0,11	0,00	**6**
P13	0,00	0,00	0,00	0,00	0,00	0,11	0,11	0,00	**6**
P14	0,27	0,11	0,00	0,00	0,10	0,11	0,11	0,00	**1**
P15	0,09	0,00	0,17	0,00	0,10	0,11	0,11	0,36	**8**
P16	0,00	0,00	0,00	0,30	0,00	0,00	0,11	0,00	**4**
P17	0,09	0,00	0,00	0,00	0,00	0,00	0,22	0,00	**7**
P18	0,09	0,00	0,00	0,00	0,30	0,00	0,00	0,00	**5**
P19	0,09	0,22	0,33	0,00	0,00	0,00	0,11	0,09	**3**
P20	0,18	0,11	0,00	0,00	0,50	0,22	0,44	0,00	**5**
P21	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,18	**8**
P22	0,00	0,00	0,00	0,00	0,00	0,22	0,11	0,09	**6**
P23	0,00	0,00	0,00	0,00	0,20	0,00	0,22	0,09	**7**
P24	0,00	0,00	0,00	0,00	0,00	0,33	0,11	0,00	**6**
P25	0,09	0,22	0,00	0,00	0,00	0,00	0,00	0,00	**2**
P26	0,00	0,00	0,00	0,00	0,10	0,00	0,11	0,09	**7**
P27	0,00	0,00	0,00	0,40	0,00	0,11	0,11	0,00	**4**
P28	0,09	0,00	0,00	0,00	0,00	0,00	0,22	0,45	**8**
P29	0,00	0,11	0,00	0,00	0,00	0,11	0,00	0,00	**2**
P30	0,00	0,00	0,00	0,00	0,00	0,00	0,11	0,00	**7**

5.2.1 Findings

The analysis of the initial interview has led to the identification of eight user segments: *attentive health guards, compassionate parents, complainers, responsible caretakers, info geeks, indifferents, social butterflies,* and *physical activity supporters.* Table 5.3 shows the characteristics and typical behaviors of personas.

Table 5.3. Persona characteristics and typical behaviors and participants showing the characteristics of each persona.

Persona	Persona characteristics and typical behaviors	Participants
Attentive Health Guards	• Trying out alternative treatment methods in case of health issues as complementary to medical treatment • Observing the dog's health and behaviors closely in case of a health problem • Need to monitor the changes in dog's digestive issues to pinpoint the affecting factors • (A constant) effort to make the dog lose weight due to concerns over any potential health problem / to prevent any health problems in the future • Decreasing the amount of food to prevent the dog gaining weight • Increased concerns over the dog's health due to medical history/past trauma • Being concerned about meeting the dog's activity needs due to him having low energy levels • Adapting certain daily / household practices acc to dog's allergic reaction to chemicals • Need to learn about the dog's calorie intake and activity needs as to being inclined to gain weight • Difficulty in determining the right amount of feeding acc to variables such as activity level, climate - especially not to trigger dog's digestive issues • Concerns over the dog's habit of eating unwanted things outside	P2, P6, P14
Compassionate Parents	• Taking the dog to work not to leave her alone • Need to understand the dog's affective states during behavioral/health issues to better help him • Concerns regarding meeting the dog's activity needs due to lifestyle affected by cultural habits - spending time mostly at home • Feeding the dog everything s/he wants out of compassion - Dealing with skin problems on the dog due to not being fed according to food allergies/sensitivities • Being concerned about meeting the dog's activity needs after change in lifestyle • Leaving dog to dog kindergarten especially during times of illness not to leave him alone • Overfeeding the dog out of compassion	P11, P25, P29

	• Avoiding to reflect negative emotions to the dog due to concerns over it might negatively impact him • Going everywhere and traveling with the dog	
Complainers	• Cleaning certain parts of the dog after returning home from outdoors • Caretaker taking parasite medication herself due to the increased concern related to the dog's contagious parasite condition • Being concerned about hygiene due to dog defecating at home • Requiring to limit the dog's access to certain rooms at home due to concerns over hygiene/cleanliness • Covering the sofas with sheets and buying vacuum cleaners due to concerns over cleanliness of the home • Being worried about leaving the dog alone due to concerns over barking	P1, P4, P19
Indifferents	• Being less concerned on dog's health due to being a veterinarian - unwillingness to adopting any product for monitoring/tracking • Having difficulty taking the dog out due to busy daily schedule • Fulfilling activity needs mostly through play due to limitations regarding busy lifestyle • Walking the dog once every two (or more) days due to time limitation • Concerns over the consistency of activity habits in busy life schedule • Not having many concerns regarding the dog's health • Setting a time limit for play/activity duration based on the carer's tight schedule • Not visiting the vet regularly • Having a fixed daily routine and no intention to change it • Intending to relinquish the dog due to the belief that he is not a good fit as a working dog	P5, P10, P16, P27
Info Geeks	• Need of verifying the assumptions about dog's activity level on the factual data • Reading academic articles on dog welfare and consulting with the veterinarian • Taking notes when observing the dog's behaviors and health condition - Need to have a tool easing the process of logging observational information about the dog • Seeking professional help for dog training to understand dog's behaviors / to handle behavior problems • Accessing the correct information about dog behavior through consulting to a veterinary/expert • Searching for info about dog nutrition on the Internet and preparing homemade dog treats • Tracking the nutrition values / calorie intake via an Excel sheet • Having courses and getting certificated on dog nutrition • Making Internet search to access info about the issues related to dog care / handling behavioral problems • Tracking things like vaccinations, medications through calendar (applications) - Setting up an alarm not to forget the medication times	P3, P18, P20

Physical Activity Supporters	• Being more physically active after adopting the dog • Adopting the dog for increased physical activity • Playing with the dog both at home and outside to help her/him spend energy • Encouraging the dog to play games to fulfill her/his activity needs • Encouraging the dog to run off-leash (when there is no one around) • Effort to motivate the dog to be active (play or walking) by giving treats • Providing environmental enrichment for the dog through interactive toys to help him spend his excess energy • Doing agility sports to increase the dog's activity level - both physically and mentally • Effort to be involved various physical activities with the dog (i.e., biking, playing) to help him spend his energy	P12, P13, P22, P24
Responsible Caretakers	• Need to access to reliable source of information about dog care • Using a camera to monitor dog remotely to check on any potential behavioral / health issues • Need to monitor dog remotely to check on any potential behavioral / health issues • Organizing daily schedule around dog's needs • Organizing home decoration according to dog's behavioral issues • Limiting social life to a certain extent due to caregiving responsibilities • Encouraging dog to play with the caretaker to reinforce the human-dog bond and effects of training • Having an allocated room for the dog due to concerns over him harming himself when left alone • Not letting the dog walk with anyone else due to the concern that his training/behavior might be negatively affected	P7, P8, P17, P23, P26, P30
Social Butterflies	• Socializing more with people in the neighborhood after adopting the dog • Going out only to dog-friendly places • Liking the attention of other people when having the dog nearby • Dog socializing with other dogs in the dog park • Socializing more with the other dog caretakers after adopting the dog • Having an active social media account for the dog • Organizing play dates for dogs on a chat group with other caretakers to • Need for guidance / info about the dog-friendly places to socialize with the dog • Desire for a helping hand for dog care at busy times / to socialize • Socializing with people together with the dog • Getting information on dog care from caretakers' WhatsApp groups	P9, P15, P21, P28

5.2.1.1 Attentive Health Guards

Attentive health guards are characterized by their constant effort to make their dogs lose weight either to prevent any health problems in the future or their concerns over their dogs' existing health problems, such as being overweight or inclined to gain weight. Relatedly, this group articulates difficulty in determining the right amount of feeding for their dogs, depending on variables such as activity levels, climate, and health conditions. They also mainly express their need to learn about their dogs' calorie intake, and activity needs to control their dogs' weight. The concerns over feeding in this user type are found to be directly related to dogs' existing food allergies/sensitivities, digestive issues, or other health problems (i.e., being overweight), which are highly likely to trigger further health problems, such as skin issues or other symptoms like vomiting if the caretaker does not pay attention to the type or the amount of food the dog eats. Therefore, caretakers in this user type make an extra effort to control the food portions to prevent weight gain.

> *"[P6] My dog is inclined to gain weight, so I get her blood tested every 6-7 months. Sometimes there is an increase in her liver values. That is why we try to make her lose weight. Let us run more and be more active. We are making an extra effort to make her more active. Because she is not a very active dog, as I said, she is very likely to gain weight quickly. So, it would be good for us to know how active she is daily."*

They also tend to adapt their certain household practices not to trigger their dogs' allergic reactions to certain chemicals, such as paying particular attention to the ingredients of laundry detergent or surface cleaner they use. They observe their dogs' health and behavior closely in case of any health problems to take timely action - for example, carefully observing the changes in the dog's digestive issues and trying to pinpoint the affecting factors.

5.2.1.2 Compassionate Parents

As the name indicates, this group is mainly characterized by their compassionate attitudes toward their dogs. Compassionate parents confess that they often cannot resist the urge to feed their dogs everything they want. They even overfeed them out of compassion, even if they know that they might deal with skin problems or other health issues in the end, as the dog is either overfed or not fed in accordance with the existing food sensitivities.

> *"[P25] For example, when I feed her one bowl, she eats it and stares at me like saying it is not enough. So, I feed her a little more. Well, of course, it is impossible to resist her. Also, the only thing making my dog happy is food. So, I feed her so that she becomes happy. We tried a diet for a very short time, but we could not continue it. She was so hungry. She always sits like this and looks at me whenever she wants something. You know she does not give up. Then I cannot stand it. I try not to make eye contact, but how long can I not look? Our family is also a glutton; we love food very much. That is why we can empathize with her. That is why it is so hard to make her lose weight."*

Furthermore, they express that they try to avoid reflecting negative emotions on their dogs, as they are concerned that it might negatively impact them. This group articulates a particular interest in understanding their dogs' affective states during any behavioral or health issues to help them better at those times. They are also concerned about meeting their dogs' activity needs due to their sedentary lifestyle and feel guilty about it. Another critical aspect characterizing this group relates to the attitudes and behaviors toward leaving their dogs alone at home. Compassionate parents often worry about leaving their dogs lonely, so they sometimes take them to work and prefer to travel with them. Some of them resort to solutions such as taking the dog to daycare, particularly during illness.

5.2.1.3 Complainers

This user type shows hygiene-related behaviors more often as compared to other groups. They pay more attention to consistently cleaning certain parts of their dogs after returning home from outdoors, cover sofas with sheets, and buy extra vacuum cleaners due to their concerns over cleanliness. Limiting the dogs' access to certain rooms due to hygiene concerns is another common behavior seen in this group. They are also more concerned that their dogs sometimes defecate/vomit at home due to occasional digestive problems. Some caretakers even express that they take parasite medication themselves due to the increased concern related to their dogs' infectious medical conditions.

> *"[P19] Cleaning is the hardest part for me about dog care. This is not a breed that sheds too much. Still, of course, it sheds a lot during the season transitions. Normally, my own vacuum cleaner was enough for me as I live alone, so cleaning was not a big concern for me. But after adopting my dog, I bought a vertical vacuum cleaner that vacuums very well. I got one of those robot vacuum mops. I bought something with an extra mat or something. I mean, I do not like laying covers on the sofas or something. I have never done such a thing in my life. But now I covered all the seats. I mean, of course, these are things easy to solve, but the things that also changed my life. But for example, paw cleaning. I wish there were something more practical solution for it."*

5.2.1.4 Indifferents

This group is primarily characterized by showing a less concerned attitude about their dogs' welfare than all other personas. Moreover, indifferents indicate an overt unwillingness to adopt any product for monitoring their dogs, which might be related to their lack of concern regarding their dogs' welfare.

Indifferents are also identified by their self-reported lack of time for performing primary caregiving practices (such as taking the dog out daily or visiting the vet regularly) or simply spending time with their dogs. Walking the dog once every two (or more) days due to time limitations, trying to fulfill their dogs' activity needs mainly through play due to a busy lifestyle, and not regularly visiting the vet are the most common behaviors identified in this user type. Nevertheless, the participants in this group also indicated their concerns regarding meeting their dogs' activity needs due to their lifestyles, such as spending more time at home rather than going out and the lack of consistency regarding their dogs' activity habits in their busy life schedule. They admit to setting a time limit for their dogs' exercise based on their tight schedule and sometimes even fulfilling the activity needs mainly through play due to time limitations.

> *"[P16] When I come home after a long day, sometimes I cannot spare time or energy for him. Even though this upsets me, I cannot even go near him because I am exhausted. He would be even more excited if I showed up. Some evenings, I send my sister to play with him and make him spend his energy a little bit. So, keeping consistency in exercise is the hardest part for me regarding dog care. I cannot always have the same energy, but he always waits for me with lots of energy."*

Walking their dogs once every two or three days by showing time limitation as an excuse, not visiting the vet regularly, and having a fixed daily routine with no intention to change it are other behavioral traits distinguishing this specific user type.

> *"[P27] I have a pretty defined daily routine; it would be good to spend more time with my dog, running more, or doing exercise, of course, but I have limited time. Maybe he could have been happier, but I think that is the best I can do. That is how I relieve myself."*

5.2.1.5 Info Geeks

Info Geeks are primarily distinguished by their constant search for knowledge about dog health and behavior. They regularly search online sources to access information about dog care and read academic articles about dog welfare. Some of them even get training on topics related to dog care, having courses, and getting certificated in dog nutrition. A few participants reported that they prepared homemade dog treats based on their research on dog nutrition because they believed it was healthier. This user type also tends to access the correct information about dog behavior through consulting with a veterinarian/behavior expert than other groups. Furthermore, most of the participants in this user type indicated their willingness to get professional help for dog training as they felt the need to understand their dogs' behaviors better.

Among the other user types, info geeks are more likely to track their dogs' medication times meticulously; some often set up alarms not to forget them. Also, they keep track of their dogs' nutrition values/calorie intake via an Excel sheet to ensure their weight and overall health. Moreover, taking notes when observing their dogs' behaviors and health conditions and carefully tracking schedules like vaccinations, medications, and vet appointments on calendar applications are other behaviors characterizing this specific user type. They also take notes when observing their dogs' behaviors and health conditions to keep track of any changes.

> *"[P18] I have once tried feeding my dog raw (BARF diet). I used an Excel sheet to calculate raw food's calories. So, it was a bit difficult, but my dog is overweight. We are trying to lose weight. We have lost four kilos now and hope to lose more. I even got a certificate in dog nutrition during the pandemic. I did not have much difficulty calculating all of these because I have an engineering background; it was something I am familiar with."*

5.2.1.6 Physical Activity Supporters

Physical activity supporters are identified with their initial motivation to adopt their dogs for increased physical activity. Aligned with this purpose, it is more common for this user type to take out the dogs for exercise more than two times a day. They all expressed that they felt more physically active after adopting their dogs.

> *"[P4] I had a dog when I was a kid. So, I knew what it was like to have a dog and that it brings many responsibilities. But I wanted to adopt him both for companionship and to increase my own physical activity. Because when you have a dog, you must simply walk daily. I wanted to exercise together with my dog."*

They also show more effort to increase their own activity levels with their dogs than other personas. Moreover, they tend to interact with their dogs through play activities - at home or outside - to help them spend their excess energy. They encourage their dogs to play games and provide environmental enrichment through interactive toys to help them spend energy. Some of them even get their dogs involved in agility sports to increase their activity levels (both physically and mentally). They also try to be involved in various physical activities with their dogs (biking, playing ball games) and encourage them to run off-leash.

5.2.1.7 Responsible Caretakers

The behaviors, attitudes, and concerns of this user type mainly comply with responsible caretaking practices, such as confinement, training, paying attention to the dog's essential needs like regular exercise, vaccination, and providing preventative veterinary care. Responsible caretakers are the largest group among all personas, with six participants. They tend to organize their daily schedule around their dogs' needs and limit their social life to a certain extent to fulfill their caregiving responsibilities. They often engage in play with their dogs and encourage them to play with themselves to reinforce the bond between them. Some provide formal training to their dogs and even avoid taking any action that they consider might negatively impact the dog's training, such as letting them walk with anyone else.

Caretakers of this user type are often concerned about leaving their dogs alone, especially in the case of any behavior or health problems such as barking or chewing on unwanted objects. Some of them resort to solutions such as monitoring remotely with a camera to check on them, particularly during times of illness. They sometimes organize their home decoration according to their dogs' behavioral issues, such as chewing on furniture, and even allocate a room for their dogs due to concerns over them harming themselves when left alone.

> *"[P20] My dog has his own room now. We only have his toys there, so many toys. Inside the room, he does not have much contact with the outside. Because he is not a dog that I can leave at home freely, so he is super active. So, he might tumble things down at home. There is also an electricity problem. He might chew on furniture, I do not mind the furniture, but he would vomit afterward. It might hurt his stomach if he swallows something. Also, seeing other animals pass by the house makes him nervous. So that is why he has a room he cannot see outside, and I leave him there when I go to work."*

5.2.1.8 Social Butterflies

Social butterflies, as the name indicates, show more tendency to socialize - together with their dogs - with other people and dogs. Most of them expressed a noticeable increase in their socialization and having a more active social life with the other dog caretakers after adopting their dogs. They also indicated that they started socializing more with people in their neighborhoods after the adoption. A few confessed they liked other people's attention when having their dogs nearby.

> *"[P9] Now, when I am in the car with my dog, people stare at him as he sticks his head out of the window. In other words, it is a beautiful dog that can somehow attract people's attention while walking together. I guess to be noticed more and see more attention is nice. So, you are part of the focus even if my dog gets the attention."*

They tend to go out mostly to dog-friendly places. Most of them stated that they organized playdates for dogs in chat groups with other caretakers, increasing their physical activity and socialization. Thus, the dogs of this user type are also more social (both with other dogs and humans) than those in other groups. A few participants also leave their dogs at dog daycare to increase the dog's interaction with other dogs. Besides, some of the participants in this user type have a particular social media account for their dogs where they share photos of their dogs, their know-how about dog care, lost pet announcements, and recipes for homemade dog treats. It has been seen that some are also involved in private chat groups for caretakers for similar purposes, such as knowledge exchange about dog care, learning from each other, and organizing playdates for dogs.

However, this user type has concerns over the limitations they face regarding their social life, travel plans, and plans about daily life due to caregiving responsibilities. Thus, they expressed their desire for a helping hand for dog care at busy times to socialize more with people.

5.2.2 Descriptive Statistics

Participants' pre-test total scores of the MDORS questionnaire, along with the sub-section scores of dog-owner interaction (DOI), emotional closeness (EC), and perceived costs (PC), are given in Table 5.4. The averages of all participants' total scores and the sub-section scores are also shown. As there is no normative data for MDORS, pre-test scores are not used to evaluate the current status of the relationships between participant caretakers and dogs. Rather, they are used to test the relationship between personas and MDORS scores, which is explained in the Section 5.2.4.

Table 5.4. MDORS scores of participants.

PARTICIPANT ID	PERSONA	MDORS PRE-TEST TOTAL SCORE	DOI SCORE	EC SCORE	PC SCORE
P02	Attentive Health Guards	75,00	31,00	30,00	14,00
P06	Attentive Health Guards	95,00	30,00	47,00	18,00
P14	Attentive Health Guards	94,00	34,00	44,00	16,00
P11	Compassionate Parents	90,00	29,00	45,00	16,00
P25	Compassionate Parents	94,00	32,00	44,00	18,00
P29	Compassionate Parents	102,00	35,00	37,00	30,00
P01	Complainers	93,00	34,00	41,00	18,00
P04	Complainers	107,00	35,00	42,00	30,00
P19	Complainers	95,00	36,00	41,00	18,00
P05	Indifferents	88,00	24,00	42,00	22,00
P10	Indifferents	76,00	20,00	39,00	17,00
P16	Indifferents	91,00	30,00	48,00	13,00
P27	Indifferents	97,00	28,00	45,00	24,00
P03	Info Geeks	106,00	35,00	39,00	32,00
P18	Info Geeks	88,00	29,00	41,00	18,00
P20	Info Geeks	91,00	38,00	34,00	19,00
P12	Physical Activity Supporters	101,00	32,00	50,00	19,00
P13	Physical Activity Supporters	84,00	27,00	45,00	12,00
P22	Physical Activity Supporters	98,00	32,00	46,00	20,00
P24	Physical Activity Supporters	92,00	36,00	42,00	14,00
P07	Responsible Caretakers	88,00	32,00	34,00	22,00

P08	Responsible Caretakers	97,00	29,00	49,00	19,00
P17	Responsible Caretakers	91,00	26,00	41,00	24,00
P23	Responsible Caretakers	96,00	31,00	38,00	27,00
P26	Responsible Caretakers	96,00	36,00	46,00	14,00
P30	Responsible Caretakers	103,00	35,00	48,00	20,00
P09	Social Butterflies	95,00	36,00	37,00	22,00
P15	Social Butterflies	106,00	37,00	47,00	22,00
P21	Social Butterflies	88,00	30,00	42,00	16,00
P28	Social Butterflies	96,00	33,00	38,00	25,00
	AVERAGE	**93,77**	**31,73**	**42,07**	**19,97**

Table 5.5 shows the participants' C-BARQ scores of the sub-scales related to the hypotheses explained in Section. As described in detail in Chapter 4, these scores indicate the averages of questions in their respective subscale. The hypotheses are explained in the following section. The scores for each sub-scale are given an ID based on the respective C-BARQ section and the related hypotheses number shown in Table 5.5.

Table 5.5. C-BARQ scores of participants.

ID	*PERSONA*	*[CBARQ1_H4] Trainability*	*[CBARQ1_H4.1] Trainability*	*[CBARQ1_H7.1] Trainability*	*[CBARQ2_H1] Aggression*	*[CBARQ2_H1.1] Stranger directed aggression*	*[CBARQ2_H5] Grooming aggression*	*[CBARQ3_H2] Fear & anxiety*	*[CBARQ3_H2.1] Stranger directed, non-social fear*	*[CBARQ3_H6] Touch sensitivity*	*[CBARQ4_H8] Separation related behavior*	*[CBARQ5_H9] Excitability*	*[CBARQ6_H10] Attachment and attention seeking*	*[CBARQ7]*	*[CBARQ7_H3] Energy level*
P02	Attentive Health Guards	3,00	3,33	2,00	0,52	0,50	0,00	0,21	0,00	1,00	1,88	1,33	1,00	0,52	3,00
P06	Attentive Health Guards	2,50	2,33	2,00	0,59	0,25	1,00	0,84	0,33	2,00	0,75	2,83	3,33	0,59	1,00
P14	Attentive Health Guards	3,.3	3,67	2,00	0,11	0,00	0,00	0,58	0,33	3,00	0,00	2,67	2,83	1,48	2,00
P11	Compassionate Parents	2,38	2,33	1,00	1,37	1,67	3,00	1,50	1,33	2,00	0,50	2,80	1,67	0,63	1,00
P25	Compassionate Parents	1,63	1,67	0,00	1,33	1,00	0,00	1,37	0,00	4,00	0,50	2,83	3,00	0,60	0,00
P29	Compassionate Parents	3,25	3,67	0,00	0,70	1,25	0,00	0,53	0,00	0,00	0,13	3,33	2,67	2,00	4,00
P01	Complainers	2,38	2,67	2,00	0,81	0,58	0,00	0,33	0,00	2,00	0,50	1,83	1,00	0,69	1,00
P04	Complainers	2,13	1,67	0,00	1,00	0,83	2,00	0,88	0,33	3,00	1,63	3,33	3,50	1,88	2,00
P19	Complainers	2,25	2,33	1,00	0,56	0,08	2,00	1,05	0,33	3,00	0,25	3,00	3,17	0,70	1,00
P05	Indifferents	0,75	0,67	0,00	0,37	0,58	0,00	0,37	0,67	0,00	0,50	3,33	3,33	0,42	1,00
P10	Indifferents	1,67	1,67	0,00	1,00	1,00	0,00	0,33	0,33	0,00	1,67	3,67	3,33	2,00	4,00
P16	Indifferents	2,50	2,67	1,00	1,22	0,75	3,00	1,12	0,33	4,00	0,88	3,00	3,17	1,56	4,00

P27	Indifferents	1,57	2,00	0,00	1,44	0,92	1,00	1,65	0,67	0,00	1,67	3,25	3,00	2,17	4,00
P03	Info Geeks	1,88	2,00	2,00	1,38	1,45	3,00	2,39	2,33	3,00	2,38	2,50	2,17	1,41	2,00
P18	Info Geeks	3,25	3,00	3,00	0,30	0,25	0,00	0,42	0,00	1,00	0,38	2,00	2,50	0,70	0,00
P20	Info Geeks	2,25	2,67	0,00	0,96	0,92	0,00	1,68	2,33	4,00	0,50	2,83	2,00	1,52	3,00
P12	Physical Activity Supporters	2,13	1,67	1,00	0,78	1,00	0,00	0,37	0,67	0,00	0,88	2,83	2,50	1,50	3,00
P13	Physical Activity Supporters	1,63	1,67	2,00	1,89	1,83	0,00	2,16	2,67	3,00	0,63	2,00	2,50	1,04	2,00
P22	Physical Activity Supporters	2,50	2,33	1,00	0,00	0,00	0,00	0,37	0,00	1,00	0,88	2,67	2,67	0,22	0,00
P24	Physical Activity Supporters	3,63	3,67	3,00	0,04	0,08	0,00	0,47	0,00	3,00	0,25	3,17	1,33	0,52	3,00
P07	Responsible Caretakers	3,00	3,33	2,00	0,56	0,00	1,00	0,32	0,00	1,00	1,50	3,50	0,83	0,84	2,00
P08	Responsible Caretakers	1,88	2,00	0,00	2,11	2,42	4,00	2,37	2,67	2,00	1,63	3,67	3,67	1,56	1,00
P17	Responsible Caretakers	2,43	3,00	2,00	0,04	0,00	0,00	0,37	0,33	2,00	0,38	1,33	0,60	0,67	0,00
P23	Responsible Caretakers	3,13	3,67	0,00	0,95	0,55	0,00	0,94	0,33	0,00	1,13	3,17	2,17	1,00	3,00
P26	Responsible Caretakers	3,75	4,00	3,00	0,70	1,09	0,00	0,74	1,33	2,00	0,00	1,17	1,83	0,27	2,00
P30	Responsible Caretakers	1,63	2,00	0,00	1,44	1,17	0,00	0,16	0,00	1,00	0,38	2,67	2,33	1,11	1,00
P09	Social Butterflies	3,13	3,33	3,00	1,48	1,08	0,00	0,58	0,33	1,00	0,13	4,00	2,83	0,93	1,00
P15	Social Butterflies	2,50	3,00	2,00	0,33	0,17	0,00	0,63	0,67	1,00	0,00	2,00	2,17	0,41	0,00
P21	Social Butterflies	2,25	3,00	0,00	0,67	0,00	3,00	1,42	1,33	2,00	0,50	3,67	1,67	1,22	3,00
P28	Social Butterflies	2,50	3,00	2,00	0,00	0,00	3,00	0,89	1,00	0,00	0,57	3,00	2,67	1,58	3,00
	AVERAGE	**2,40**	**2,60**	**1,23**	**0,82**	**0,71**	**0,87**	**0,90**	**0,69**	**1,70**	**0,77**	**2,78**	**2,38**	**1,06**	**1,90**

5.2.3 Hypotheses on Caretaker Personas

To see whether there was any relationship between the participant dogs' C-BARQ scores and the caretaker personas, the co-supervisor of the thesis study and a dog behavior veterinary expert (Assoc. Prof. Dr. Yasemin Salgırlı Demirbaş) formulated twelve hypotheses in total based on the persona types and the potentially related sections and sub-sections of C-BARQ (Table 5.6).

Dogs can demonstrate various behaviors that signal stress and distress. Stress is not a phenomenon that is only experienced by humans (Rothberg & Collins, 2015). Dogs may display signs of distress in subtle ways, progressing from minor indications like paw lifting to more noticeable aggressive behavior, such as growling, snapping, or biting (Shepherd, 2009). Depending on a particular dog's tolerance level, an overstimulated/stressed dog may become aggressive (Rothberg & Collins, 2015). Furthermore, fearful behavior is another way a dog may communicate increased stress (Hakanen et al., 2020). Studies have found that a multitude of factors, such as dog age, sex, and weight (McGreevy et al., 2013; Dinwoodie, 2019), caretaker personality, human-dog attachment (Konok et al., 2015; Gobbo & Zupan, 2020), and environmental factors (Rothberg & Collins, 2015) influence dog behavior and temperament. For example, Podberscek and Serpell (1997) discovered that caretakers of aggressive dogs were likely to possess characteristics such as emotional instability, shyness, tension, and lack of discipline. This was supported by Gobbo and Zupan (2020), who observed higher levels of neuroticism among the caretakers of aggressive dogs. In addition, Dodman et al. (2018) determined that dogs with carers who scored low in extraversion, conscientiousness, and emotional stability on personality tests had higher levels of stranger-directed fear. Regarding human-dog attachment, Konok et al. (2015) identified increased separation-related behavior in dogs whose caretakers had insecure-avoidant attachment styles. Furthermore, Hoffman et al. (2013) observed a positive correlation between separation-related behavior, trainability, and the strength of the owner-dog attachment (as cited in Powell et al., 2021).

It is also known that environmental factors can also trigger certain behaviors in dogs. For instance, a study recently conducted by Puurunen et al. (2020) found a relationship between a living environment and social fear in dogs. Urban life raises stress levels due to the hectic atmosphere and high population density of humans and dogs (Hakanen et al., 2020). This can lead to increased stress in dogs, which can be expressed as fearful or aggressive behavior (Hakanen et al., 2020). Lan et al. (2022) found a positive correlation between anxiety levels in humans and crowdedness. Additionally, the research revealed that various environmental factors (green space, blue space, noise, air pollution, and crowdedness) had a non-linear correlation with anxiety symptoms in participants. Based on these findings, it can also be assumed that too much social exposure or sensory overload present in urban life could lead to overstimulation/anxiety in dogs, similar to their human companions. Moreover, a study by Rothberg and Collins (2015) shows that service dogs can behave aggressively in certain social contexts, such as in psychotherapy group sessions, as exposure to high levels of stimulus in such settings might be intolerable for some of them. Similarly, certain daily scenarios, such as playtime or the arrival of the caretaker or other guests at home, were found to prompt excitable behavior in dogs, for example, jumping on people, nipping, and even biting (Shabelansky & Dowling-Guyer, 2016). Although such attention-seeking and excitable behaviors are often regarded as undesirable by carers (Shabelansky & Dowling-Guyer, 2016), studies indicate that these behaviors are associated with specific caretaker characteristics (Jagoe & Serpell, 1996; O’Farrell, 1997).

In addition to environmental elements, physical exercise is another major factor influencing canine behavior. Studies show that excessive physical activity can lead to increased stress, resulting in arousal or over-excitement in dogs (Lee & Kim, 2020). Arousal can be described as a physiological response to emotional or physical triggers (Denenberg, 2020). Both physical and cognitive over-stimulation and boredom can be sources of stress for dogs (Townsend & Gee, 2021). In other words, under exercised dogs can also become overstimulated and agitated. Dogs need not only food, water, and opportunities to relieve themselves but also social interactions (e.g., affection, play, and training), adequate exercise, and sufficient time for sleep and rest (Denenberg, 2020) to live a full and satisfying life.

Since dogs cannot communicate their needs and concerns verbally, their behaviors must be interpreted. Research demonstrates that humans often overlook minor indications of dog stress, even in their own companion animals (Mariti et al., 2012). Several factors can make it more difficult to distinguish these stress signals, including the breed of dog (facial and body features), the relationship between the dog and caretaker, and how the dog is trained to react to distress. Plus, the same signal can change depending on the context; a yawn at bedtime at home may have a different meaning than one in a social setting (Buttner & Strasser, 2014). Caretakers should be especially careful since early signals of stress can be very hard to detect. However, it is essential to interpret these stress signals in order to prevent the development of more serious behavior issues (Townsend & Gee, 2021). Most of the hypotheses were created on the basis that excessive exercise and social exposure result in overstimulation in dogs, which might result in a number of behavior problems.

For physical activity supporters, given their motivation for being physically active with their dogs, it is reasonable to assume that this may lead to overstimulation or a constant state of arousal in dogs due to excessive exercise. This can lead to aggression in dogs. Therefore, it is hypothesized that aggression, as well as fear and anxiety scores, may be high in dogs whose caretakers are in this group. The subcategories of the C-BARQ, stranger-directed aggression, fear and anxiety, and touch sensitivity, were also examined separately for this type of caregiver. In addition, it was anticipated that the energy scores of dogs in this group might be high, likely as a result of being in a constant state of arousal due to excessive exercise. On the other hand, it was hypothesized that the trainability scores of the responsible caretakers might be high because the caretakers in this persona were likely to be more knowledgeable about dog training and more inclined to engage their dogs in formal/informal training regarding their characteristics. However, their aggression scores for grooming practices and veterinary examinations may be high due to the increased likelihood of frequent grooming and veterinary visits in this persona.

Similar to responsible caretakers, the trainability scores of dogs whose caretakers are Info Geeks may be high due to the owner's characteristics. On the other hand, in the case of social butterflies, overstimulation in dogs may be the result of too much social exposure with their human companions. Thus, dogs in this group may be predisposed to show signs of arousal and stress. As a result, their aggression scores related to stranger-directed aggression and touch sensitivity may be high. Similarly, their fear and anxiety scores related to stranger-directed fear, touch sensitivity, and non-social fears (e.g., noise, thunderstorm) may also be high. There is also the possibility that their separation anxiety and excitability scores may be high due to the constant presence of their caregivers. The indifferent persona, on the other hand, may have high Attachment and Attention Seeking scores due to lack of exercise. Energy scores may also be high due to unmet physical activity needs. Finally, trainability scores may be low because this group is less likely to engage their dogs in formal or informal training.

Table 5.6. Hypotheses for the relation between personas and C-BARQ scores.

	Personas					
CBARQ Sub-Scales	**Info Geeks**	**Physical Activity Supporters**	**Responsible Caretakers**	**Social Butterflies**	**Indifferents**	**Complainers**
CBARQ 1 - Trainability	**H4:** Trainability scores are high		**H4:** Trainability scores are high	**H7:** Trainability scores are low	**H4:** Trainability scores are low	
CBARQ 1 - Trainability	**H4.1:** Reaction to sit and wait commands Slow when learning new tricks			**H7.1:** Easily distracted by interesting sights, sounds, or smells.		
CBARQ 2 - Aggression		**H1:** Agression scores are high		**H1:** Aggression scores are high		
CBARQ 2 - Stranger-directed aggression		**H1.1:** When approached directly by an unfamiliar adult while being walked/exercised on a leash. When an unfamiliar person tries to touch or pet the dog.		**H1.1:** When approached directly by an unfamiliar adult while being walked/exercised on a leash. When an unfamiliar person tries to touch or pet the dog.		
CBARQ 2 - Agression towards grooming practices			**H5:** Agression scores regarding grooming practices are high When bathed or groomed by a household member.			
CBARQ 3 - Fear&Anxiety		**H2:** Fear and anxiety scores are high		**H2:** Fear and anxiety scores are high		
CBARQ 3 - Stranger-directed fear		**H2.1:** When approached directly by an unfamiliar child while away from your home. When an unfamiliar person tries to touch or pet the dog.		**H2.1:** When approached directly by an unfamiliar child while away from your home. When an unfamiliar person tries to touch or pet the dog.		
CBARQ 3 - Non-Social Fear		**H2.1:** In response to strange or unfamiliar objects on or near the sidewalk (e.g. plastic trash bags, leaves, litter, flags flapping, etc.).		**H2.1:** In response to strange or unfamiliar objects on or near the sidewalk (e.g. plastic trash bags, leaves, litter, flags flapping, etc.). During thunderstorms, firework displays, or similar events.		
CBARQ 3 - Touch Sensitivity			**H6:** Fear& scores regarding grooming practices are high When examined/treated by a veterinarian.			
CBARQ 4 - Separation-related behavior				**H8:** Separation-related behavior scores are high		**H8:** Separation-related behavior scores are high
CBARQ 5 - Excitability				**H9:** Excitability scores are high		
CBARQ 6 - Attachment and attention-seeking					**H10:** Attachments and attention-seeking scores are high	
CBARQ 7 - Energy level		**H3:** Energy scores are high. Active, energetic, always on the go			**H3:** Energy scores are high	

5.2.4 Statistical Analyses

Following the identification of eight caretaker personas through the content analysis, it has been seen that these personas differ primarily based on their willingness to self-reflect on their dogs' monitoring data, forming a spectrum in this sense. Info geeks and indifferents personas were placed at the two ends of this spectrum, the former being eager to learn more about dog welfare and to self-reflect and the latter not so (Figure 5.1). To support our hypothesis that these two personas distinctly differ from each other mainly on the basis of their willingness for self-reflection, we grouped these eight personas into two and carried out the statistical analysis in this way. Indifferents formed the group called Type 1, while the remaining personas, including info geeks, formed Type 2. The main dependent variable of the study is the MDORS questionnaire, based on the idea that the persona types directly affect the current state of the dog-owner relationships. For the statistical analyses, descriptive statistics were generated, which is given in the Section 5.2.2, Table 5.4, and data were analyzed using IBM SPSS Statistics, version 28. It was assumed that the relationship between pre-test MDORS scores and these two persona groups at the different ends of the self-reflection spectrum would be examined most accurately by using One-Way Between-Subject Anova. Statistical significance was set at $p < 0.05$ for all analyses.

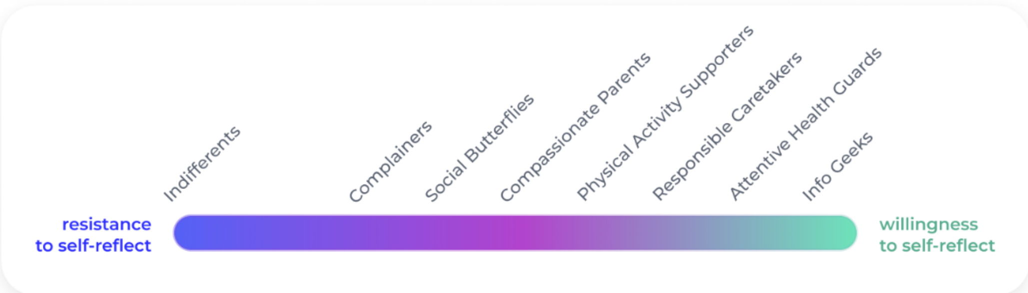


Figure 5.1. Persona scale - the spectrum of willingness for self-reflection.

When investigating the relationship between the total MDORS scores and the two groups of persona types, no statistically significant results were found. This led us to analyze the relationships between the three subscales of MDORS and personas. With this thought, the relationship between personas and the sub-scales dog-owner interaction (DOI), emotional closeness (EC), and perceived costs (PC) were separately examined. While no significant results between personas and the sub-scales EC and PC were found, there was a statistically significant relationship between persona and DOI ($F(1, 28) = [7.886]$, $p = .009$). (Figure) The 7 participants in the Type 1 group had an average DOI score of 28.29 ($SD = 4.99$), while the 23 participants in the Type 2 group had an average DOI score of 32.78 ($SD = 3.275$). Both the normality and homogeneity of variances assumptions required for One-Way Between-Subject Anova were provided. Shapiro-Wilk Test was preferred for the normality test because the sample size was smaller than 50. According to the results of this test, there was no significant departure from normality, $W(30) = 0.944$, $p = 0.116$. According to Levene's test used for homogeneity of variances, there was also no statistically significant difference between variances, $F(1,28) = 1.097$, $p = 0.304$.

In addition to these, whether there was any relationship between the C-BARQ scores, and the personas was also investigated based on the hypotheses created on the Table 5.6. Then, the C-BARQ scores of participant dogs for each related sub-section were gathered, and all these hypotheses were tested by using One-Way Between-Subject Anova and Kruskal Wallis Test in SPSS to see whether there was any statistically significant relationship between the related variables. The test results revealed statistically significant differences in the three hypotheses.

The first statistically significant result is between the group indifferents' scores of the Attachment and Attention Seeking Behavior which is the sixth sub-section of the questionnaire, and other personas' Attachment and Attention Seeking Behavior scores ($F(1, 28) = [5.109]$, $p = .032$). Four participants in the Indifferents group had an average C-BARQ-6 score of 3.21 ($SD = 0.16$), while the 26 participants in the other personas group had an average C-BARQ-6 score of 2.25 ($SD = 0.83$). Thus, the test results proved the hypothesis that 'indifferents' Attachment and Attention-

Seeking scores are higher than the other personas.' The second statistically significant relationship among the tested hypotheses is between Indifferents' scores of Trainability which is the first sub-section of the questionnaire, and other personas' Trainability scores ($F(1, 28) = [7.704]$, $p = .010$). Four participants in the Indifferents group had an average C-BARQ-1 score of 1.62 ($SD = 0.71$), while the 26 participants in the other personas group had an average C-BARQ-6 score of 2.54 ($SD = 0.60$). This analysis also revealed the hypothesis that 'Indifferents' Trainability scores are lower than other personas.' For the test of these two hypotheses, One-Way Between-Subject Anova was used because the assumptions of normality and homogeneity of variances were provided, but for the third hypothesis, Kruskal Wallis Test was applied because the assumption of normality could not be met. According to the results of the Kruskal Wallis Test, a statistically significant relationship was found between Indifferents' energy scores, which is included in the seventh sub-section of the questionnaire, and other personas energy scores $H(1) = 4.247$, $p = .039$, with a mean rank of 23.75 for indifferents' C-BARQ-7 score and 14.23 for other personas C-BARQ-7 score. The last test also proved the hypothesis that 'Indifferents energy scores are higher than other personas.' Considering the other hypotheses tested during the analysis, no statistically significant relationship was found.

5.3 Discussion on Caretaker Personas

Dog activity monitoring devices hold the potential to increase caretakers' awareness of their dogs' welfare. However, as presented in Chapter 3, raising awareness and behavior change are complex and challenging tasks that require careful consideration of many interrelated aspects. To design successful interventions that would enable dog caretakers to improve their caregiving quality through increased awareness, a holistic approach is necessary. This approach should take into account dogs' needs and the complex interspecies relations within these information systems, as explained in Chapter 2. Moreover, selecting the right caretaker persona and deciding on the fitting intervention type is also critical for increasing humans' awareness of their dogs in compliance with these design strategies. Therefore, it is critical to identify different caretaker personas and their characteristics before designing interventions.

As mentioned before, people use dog monitoring data to reflect on the issues related to their dogs' welfare, such as their physical activity and feeding. This self-reflection on the data can help people to become more aware of their own behavior (Carver & Scheier, 2001), make better decisions (Endsley, 1997), and change their behavior (DiClemente, 2001). However, users' self-reflection processes differ based on their unique characteristics and personalities regarding their personal data (Bentvelzen et al., 2021), also affected by a number of interconnected variables related to data and lifestyle (Coşkun & Karahanoğlu, 2022). Therefore, to better support caretakers' self-reflection processes and help them turn monitoring data into useful insights about their dogs' lives, it is necessary to provide this data in a suitable way based on their level of willingness for self-reflection.

Considering the caretaker personas identified in this study, info geeks need to access more information about their dogs' welfare. They are also eager to log additional information related to their dogs to track any changes in their health and well-being. Therefore, providing contextual and detailed insights about dogs via these devices might be a strategy aligned with info geeks' information needs and their will to self-reflect on the data. Whereas, for indifferents, delivering more targeted information in an easily digestible way might be a more effective strategy to assist self-reflection, as they have difficulty fulfilling even the basic caregiving responsibilities. On the other hand, attentive health guards specifically need to learn about the calorie intake of their dogs to control their weight and to balance their physical activity and feeding levels based on different variables. Thus, providing them with more tailored information about their dogs' needs would be more likely to contribute to their caregiving quality by addressing their concerns and information needs via these systems. However, compassionate parents need to understand the affective states of their dogs to communicate with them and address their needs better. Thus, offering them better guidance about dog behavior for increased communication through informative content can be more meaningful for them in terms of self-reflection.

On the other hand, social motivation strategies might be utilized for social butterflies to support their caregiving. As explained in detail in Chapter 2, the social role of technology is emphasized in behavior change strategies applied in persuasive technologies (Fogg, 2003). Besides, enabling social learning, social comparison, social facilitation, cooperation, and competition among users are suggested as effective design strategies for computerized systems (Oinas-Kukkonen & Harjumaa, 2008). Aligned with these strategies, creating a community and a platform to connect with other caretakers to enable learning from each other, exchange knowledge, and cooperation might be an effective intervention area for design. Moreover, enabling integration with caretakers' social media accounts can also be motivating for this user type, which can allow them to socialize online and create a ground for comparison and competition. Lastly, for physical activity supporters, informing them better about their dogs' activity needs based on age, breed, weight, and health condition can be useful to favor dog welfare, considering their constant effort to keep their dogs active. It is a common misconception about dog care that more physical activity is always better for dogs. However, physical activity needs among dogs vary based on different factors such as breed characteristics, age, weight, health condition, behavioral problems, and individual differences (Coile, 2015; The Kennel Club, 2023). Thus, increased activity may do more harm than good in some cases.

As mentioned in the Statistical Analyses Section, the test results revealed that there was a statistically significant relationship between the indifferents' C-BARQ scores of the Attachment and Attention Seeking Behavior and other personas' scores in the same category. In other words, their scores in this sub-section were significantly higher as compared to other personas. Moreover, their Trainability scores were lower, and their Energy Level scores were significantly higher based on the analysis results. A dog with a high score in attachment and attention-seeking behavior is likely to want to be close to their caretaker and seek affection or attention from them. This may indicate that the dog requires more attention and interaction from their caretaker and may become anxious or agitated if they do not receive enough attention. Similarly, a high energy level score suggests that the dog may require more exercise and playtime to keep them physically and mentally stimulated. On the other hand, a low score in trainability may suggest that the dog is less responsive to training and commands from their caretaker. This could be due to a lack of training or inconsistent training from the caretaker, which may lead to frustration and a sense of disconnection between the human and the dog.

Based on these results, it is not possible to associate indifferents' less-concerned approach with the lack of any existing behavior problems in dogs, as the scores indicate that the dogs of this caretaker type exhibit overt signs of attachment and attention-seeking behavior with high energy levels. Furthermore, the behavioral problems among dogs in this group may be linked to the prevailing caregiving practices in this user type, such as a self-reported lack of time to perform primary care practices (such as taking the dog out daily or visiting the vet regularly) or simply spending time with their dogs, and walking the dog once every two (or more) days due to time constraints, which are identified through the qualitative analysis. Therefore, it can be assumed that this user type shows unconcerned behaviors with disregard for their dogs' welfare, despite their existing behavior problems identified through statistical analysis. It is crucial to increase the awareness of caretakers about these issues related to their dogs' problems and unmet needs to develop better caregiving practices. They may need to adjust their behavior, such as providing more attention and exercise, using different training techniques, or seeking professional help to address any behavior issues that may arise.

It was also found that the average energy scores of the dogs whose carers belonged to the Indifferents persona were significantly higher than the other groups. Again, this finding may be related to the dogs' unmet physical activity needs or lack of consistency in physical activity. As discussed in the Hypotheses on Caretaker Personas Section, under exercised dogs may also become overstimulated and agitated, which can result in high energy levels (Mariti et al., 2018; Herron et al., 2014; Rooney & Cowan, 2011). In addition, the trainability scores of dogs in this group were also lower than other personas. This may be explained by this group's unwillingness to engage their dogs in formal or informal training due to their behavioral characteristics, such as lack of time or willingness to fulfill basic caregiving responsibilities. However, when considering any design interventions, it should also be kept in mind that indifferents show an apparent unwillingness to adopt any product to monitor their dogs, which may be related to their lack of concern for their dogs' welfare. Considering the other hypotheses tested during the analysis, no statistically significant relationship was found. This may be due to the fact that the sample size was too small to detect a statistically significant difference during the analysis.

Based on the findings presented in this Chapter, the information needs of the identified caretaker personas are summarized in Table 5.7. When designing interventions to better utilize the persuasive potential of DAMS for behavioral change and for improving the quality of caregiving practices among caretakers, these varying needs should be taken into account. By understanding the varying needs of different personas, these interventions can be tailored to be more effective and persuasive. For example, a technology-based intervention for an Indifferent persona may need to focus on reminding them to spend more time with their dog, whereas an attentive health guard persona may benefit from information on how to balance their dogs' calorie intake and activity needs, as well as information on the right feeding amount based on variables such as activity level and climate. Overall, understanding the different information needs of different caretaker personas is important for designing interventions that can help promote better dog welfare and improve the relationship between dogs and their caretakers. The study highlights the importance of designing tailored interventions that meet the specific needs of each persona to ensure that the information provided is relevant, engaging, and effective in enhancing their awareness and supporting their caregiving quality.

Table 5.7. Information needs of personas.

Persona	Information need
Info Geeks	Reliable and detailed information on dog welfare, behavior, and nutrition to ease their access to knowledge
Attentive Health Guards	Dogs' calorie intake and activity needs, information on the right feeding amount based on variables such as activity level and climate
Responsible Caretakers	Information on the dogs' overall well-being when left alone - remote monitoring
Physical Activity Supporters	Correct information on the dogs' exercise needs based on differences such as breed, age, health condition
Compassionate Parents	Information on dog behavior to help them better understand their dogs' affective states and behaviors
Social Butterflies	Enabling learning from each other and exchange of knowledge among caretakers on dog care
Complainers	Tips to maintain hygiene during dog care and correct information to mitigate their hygiene concerns
Indifferents	Easily digestible information to raise awareness on the basic dog care practices

CHAPTER 6

DIMENSIONS TO INCREASE HUMANS' AWARENESS VIA DAMS TO IMPROVE THEIR CAREGIVING OF DOGS

This chapter presents the major findings of the study related to the dimensions to increase humans' awareness of dogs through dog activity monitoring systems (DAMS). First, the DAMS-mediated awareness model is described that is created based on the dimensions identified in the analysis. While demonstrating the stages of DAMS-mediated awareness, the model also serves as a layout guiding the narrative in this chapter. The dimensions elicited from the data analysis are grouped into three categories based on the stages of the model: making sense of tracking data, reflecting on tracking data, and behavior/action. The dimensions related to each stage and their characteristics are explained under these categories. Finally, the implications of DAMS use and barriers to long-term DAMS adoption are presented.

6.1 DAMS-Mediated Stage-Based Awareness Model

Based on the dimensions to increase caretakers' awareness identified through the qualitative analysis of the second interview data and the synthesis of the literature review presented in Chapter 3, a model is developed to demonstrate the information processing via DAMS (Figure 6.1). The dog activity monitoring system-mediated awareness model in Figure aims to illustrate the relationships between data collection, sensemaking, and reflection processes and how they relate to the target behavior/action. According to the model, the process starts with the caretakers' interaction with DAMS. After that, the data Collection process begins, where large amounts of monitoring data related to dogs' physical activity are collected, along with feedforward and feedback from the system. During this stage, users monitor different types of information related to their dogs, such as physical activity and sleep quality. On the user side, this information provided by the technology must first be processed in their cognition. Since users are generally overloaded with a large amount of tracking information at this phase, they need to filter and synthesize it for further mental processing.

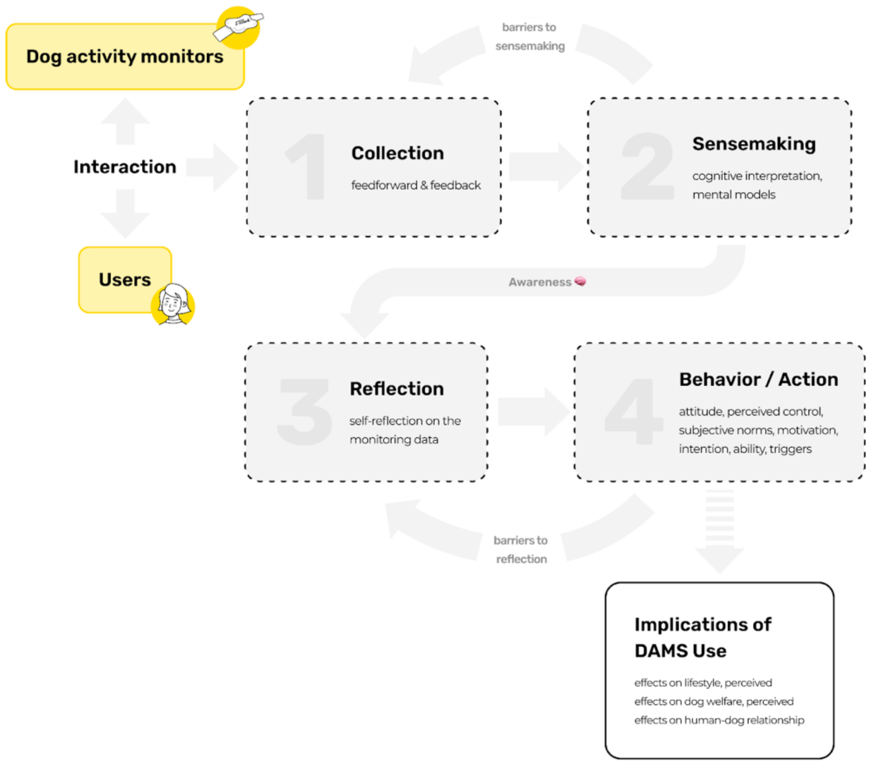


Figure 6.1. DAMS-mediated stage-based awareness model.

Following the *Data Collection* stage, the *Sensemaking* phase starts, which is an essential step of the information processing model. In this stage, the sensor data collected and provided via DAMS is interpreted by the caretaker. Throughout these stages, various factors, such as the persona types of the caregivers in terms of their attitudes, habits, and intentions, as well as the dog's characteristics, may influence the entire process. At this stage, users may encounter various barriers that may be related to the system, user, or data. However, barriers encountered at the

Sensemaking stage may prevent users from transitioning to the Reflection stage. At the Reflection stage, caretakers start to reflect on the tracking data and also their caregiving behaviors and practices after interpreting and understanding this information at the *Sensemaking* stage. Similarly, the barriers faced at the *Reflection* stage can hinder caretakers from properly self-reflecting on their dogs' tracking data and turning this data into meaningful insights into their lives. Lastly, at the final stage of the model, the *Action* stage, caretakers take action on the insights they gain from the reflection phase and make positive changes related to their lifestyles, caregiving practices, and behaviors. In this chapter, the dimensions to increase caretakers' awareness via DAMS identified through the study are presented by positioning them within the model's structure.

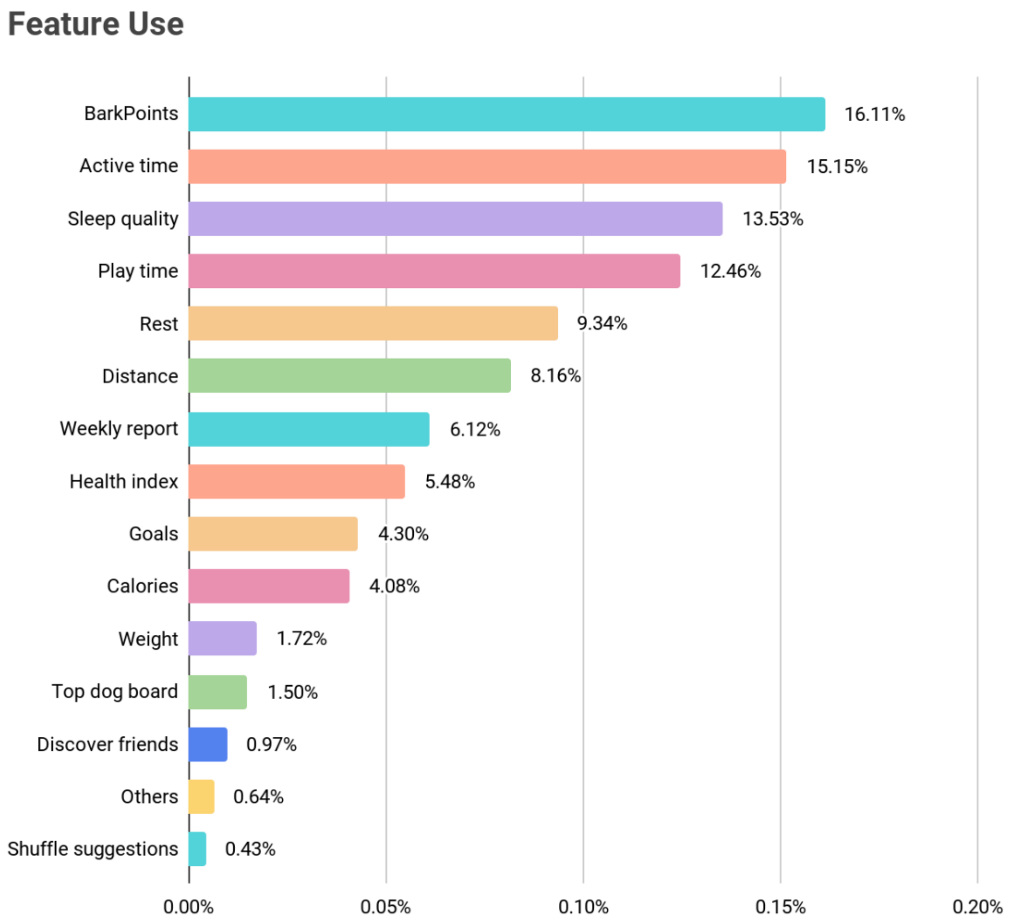
6.2 Descriptive Statistics

In this section, descriptive statistics related to the responses to the ESM survey, MDORS t-test results, and participants' attitudes toward the long-term adoption of the device are presented.

6.2.1 ESM Survey Results

As described in detail in Chapter 4, the ESM survey was sent to the participants via an online form twice every week for six weeks. The short survey consisted of questions related to the most used app features, the most useful app features as perceived by the participants, and the weekly frequency of app use. Table 6.1 shows the frequency distribution of app feature usage by all participants based on the survey responses during the study period. It is seen that the top three most frequently used app features/the most used data type by participants are barkpoints (%16.11), active time (%15.15), and sleep quality (%13.53).

Table 6.1. ESM results regarding the most used Fitbark app features.



As seen in Table 6.2, the most useful app features, as perceived by the participants, are similar to the results of the most frequently used app features. Barkpoints score (%18.4) is found to be the most useful app feature/data type on the app, followed by active time (%16.74) and play time (%13.14).

Table 6.2. ESM results showing the most useful Fitbark app features as perceived by the participants.

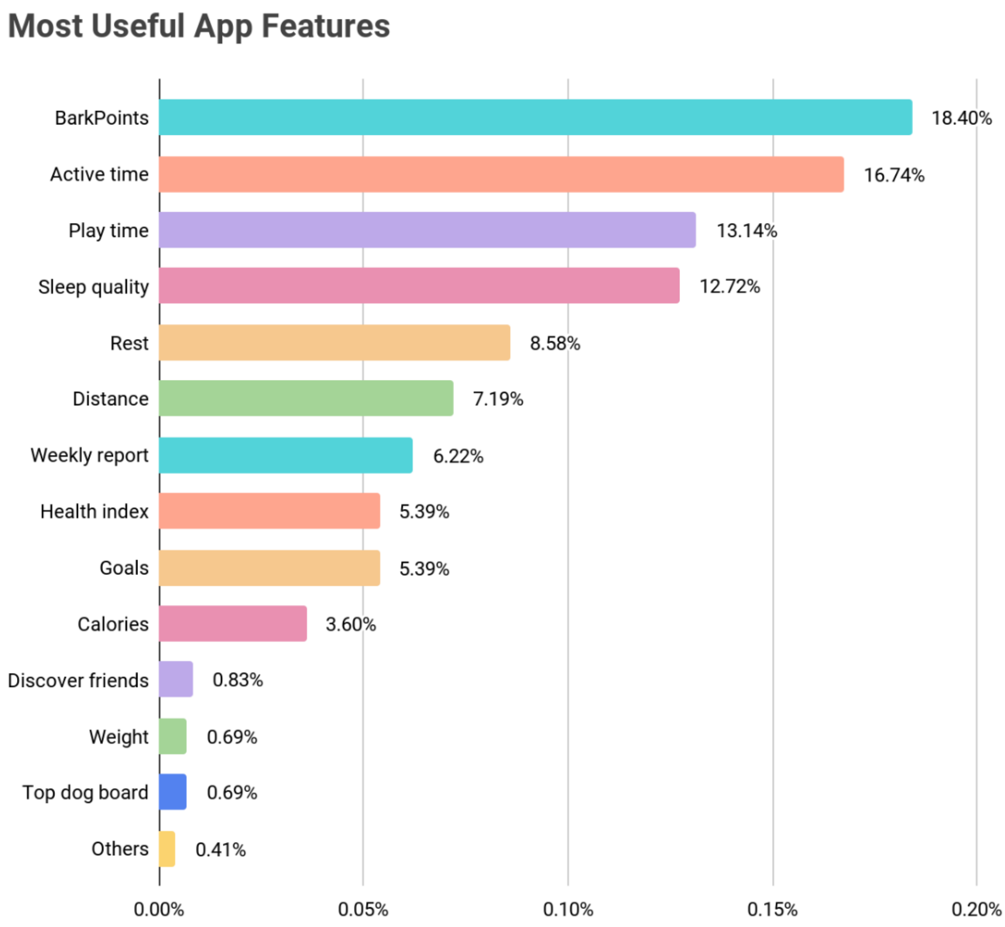


Table 6.3 shows the weekly app use frequency of all participants during the study period. It is seen that the app is used more than three times a day by %36.73, one or two times a day by %35.71, once a day by %25.05, and %2.04 never used it within the week.

Table 6.3. ESM results of the participants' use frequency of the Fitbark app.

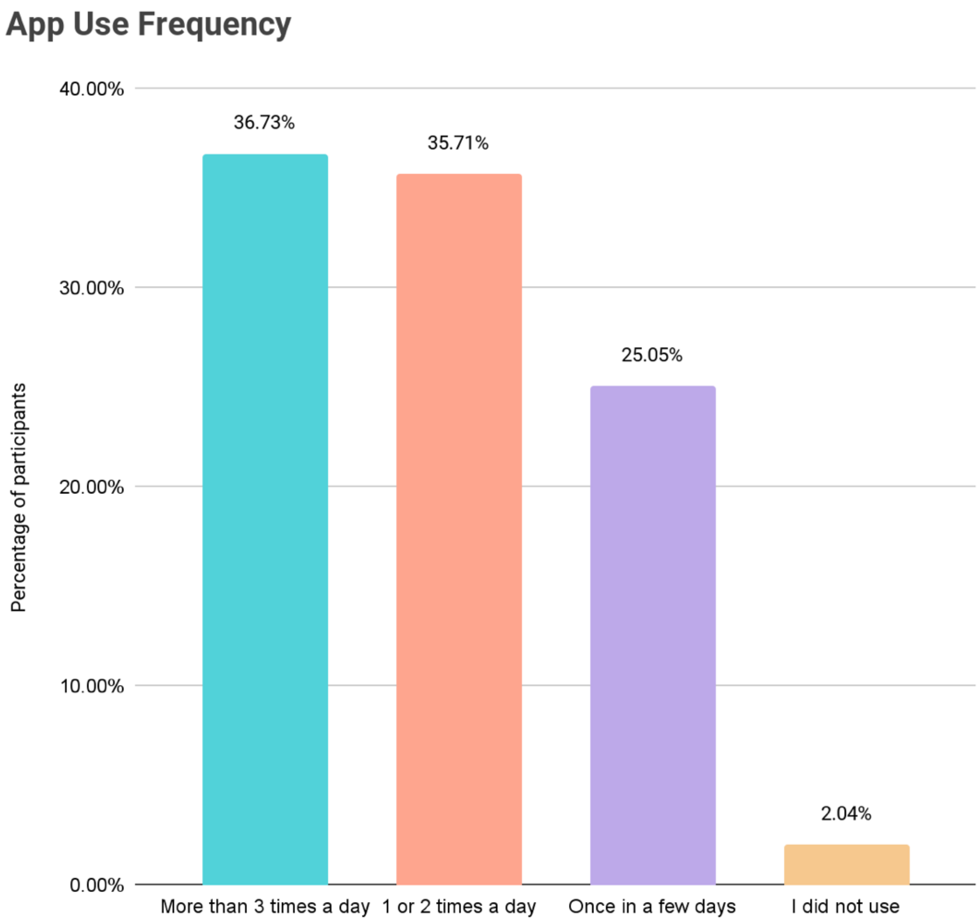


Table 6.4 shows the participants' preferences for the long-term adoption of the device. 21 out of 30 participants were positive about continuing to use the device, while 2 of them were neutral, and 7 were not willing to keep using the device. Four out of seven participants who were negative about the long-term adoption of the product stated that they would use it if it had more features such as GPS.

Table 6.4. Participants' opinions about continuing to use/long-term adoption of the product.

Participants	Positive	Neutral	Negative
P1	•		
P2	•		
P3	•		
P4	•		
P5	•		
P6	•		
P7	•		
P8	•		
P9	•		
P10			•
P11	•		
P12	•		
P13		•	
P14			•
P15			•
P16	•		
P17	•		
P18	•		
P19	•		
P20	•		
P21		•	
P22	•		
P23			•
P24			•
P25	•		
P26	•		
P27			•
P28			•
P29	•		
P30	•		
Total	**21**	**2**	**7**

6.2.2 MDORS T-Test Results

T-test analysis was conducted to compare the mean scores of the pre-study (M = 93.76) and post-study (M = 93.73) MDORS questionnaire. The results showed that there was no statistically significant difference between the MDORS scores, as indicated by the t-statistic of 0.03, which was smaller than the one-tailed critical value of $t = 1.69$ at $p < 0.05$. Therefore, it can be concluded that the use of the device did not have a statistically significant impact on the human-dog relationship of participants during the study period. T-test results are shown on the Table 6.5.

Table 6.5. MDORS t-test results.

t-Test: Paired Two Sample for Means

T-TEST		***Variable 1***	***Variable 2***
0,970256825	**Mean**	93,76666667	93,73333333
	Variance	57,77126437	52,82298851
	Observations	30	30
	Pearson Correlation	0,772862077	
	Hypothesized Mean Difference	0	
	df	29	
	t Stat	0,036365502	
	P(T<=t) one-tail	0,485620047	
	t Critical one-tail	1,699127027	
	P(T<=t) two-tail	0,971240094	
	t Critical two-tail	2,045229642	

Table 6.6. Codes and sub-codes related to sensemaking.

SENSEMAKING	
Codes	**Sub-Codes**
Comprehensibility of the information	Difficulty in understanding what the data indicates / means Need to learn about how data is calculated Activity scores providing a sound basis as units to determine activity levels Need for more detailed reports on the average scores of other dogs
Contextualizing data	Making sense of the data through combining it with affecting factors Desire to have different types of data for improved contextualization Establishing a relationship between sleep and activity levels Interpreting the dog behavior by activity scores Need for more detailed reports on the average scores of other dogs Need to see location-based / seasonal data related to other dogs Desire to monitor dog's affective states Desire to monitor mental activity Desire to monitor heart rate to evaluate the exercise effectivity Desire to monitor heart rate due to health issues Calibrating decisions about physical activity duration Making assumptions about the dog's health condition based on the disruptions on sleep quality data Decision-making about adjusting the feeding amount Experimenting by making small changes to see the factors affecting sleep quality Raising awareness about the dog's sleep quality when away Raising awareness about effects of the carer's daily schedule/actions on dog behavior / sleep quality
Sensemaking through comparison with other dogs	Need for making sense of the data through comparing it to similar dogs / Evaluating well-being status in comparison to other dogs Making sense of the data by comparing the active / rest times to similar dogs Desire to compare dogs in the nearby location/same country for a more relevant comparison
Sensemaking through comparison with familiar data	Evaluating well-being status based on specific type of data Establishing a relation between the effectivity of physical activity and calories burned Feeling relieved by the monitoring data as an indicator of well-being Establishing a relation between the self and dog's walking distance Judging the effectivity of activity based on the distance data Making sense of the tracking activity data through comparing it to one's own data
Social / Collaborative sensemaking	Supporting socialization and knowledge exchange among caretakers Desire to connect with the carers nearby for the exchange of more context-relevant experiences Connecting with other caretakers on social media for knowledge exchange
Sensemaking with the assistance of data visualization	Ease of understanding visually represented data Judging dog's daily physical activity needs based on rest time on data graphs Focusing on a particular data highlighted through visualization Misleading data visualization used on data graphs

6.3 Making Sense of the Tracking Data

At the Sensemaking stage, it was found that several dimensions affect how caretakers interpret the dog activity monitoring data. These dimensions include; *comprehending the information*, *contextualization of the data*, *sensemaking through comparison with other dogs*, *sensemaking through comparison with familiar patterns*, *social sensemaking*, and *sensemaking with the assistance* of *data visualizations*. Table 6.6 displays the dimensions related to the sensemaking of tracking data and their related sub-codes. Moreover, caretakers adopt different strategies to make sense of the monitoring data based on several factors, such as their persona types concerning their concerns and behaviors, mental models, past experiences, and their dogs' specific characteristics. This section explains the dimensions associated with the sensemaking of the tracking data.

6.3.1 Comprehending the Information

The comprehensibility of tracking data is a dimension that has a major impact on the sensemaking process of caretakers. For example, the barkpoints score, which is the most prominent information on the app, indicates the activity scores of the monitored dogs (Figure 6.2). Although it provides a sound basis as a unit to determine dogs' physical activity levels for most participants, there was a common confusion among caretakers about what this data meant. 'Barkpoints' is defined as a proprietary point system that measures physical activity in terms of "activity counts" generated from 3D accelerometer readings (Fitbark, 2022). Thus, basically, the more the sensor moves on the dog's collar, the more points it collects. However, some caretakers interpreted the barkpoints score as a general welfare indicator considering that it was counted based on all monitoring data on the system, including sleep quality, rest, playtime, burned calories, and health index, while others perceived it as the step count of their dogs.

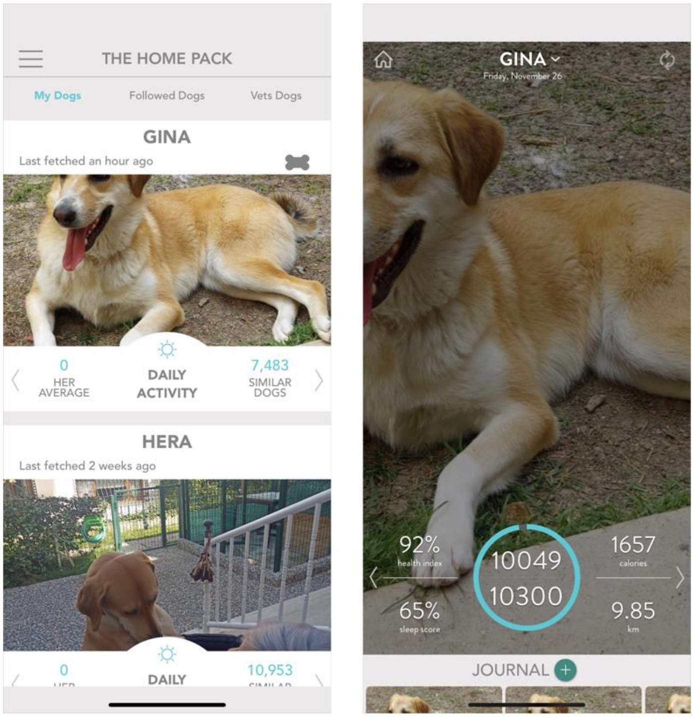


Figure 6.2. Fitbark home page (on the left), dog page with barkpoints data in the circle (on the right).

Considering that the main activity indicator on the system is barkpoints, which is highlighted by data visualizations as well, it is noteworthy that some caretakers interpreted the physical activity of their dogs based on other data types, such as distance or burned calories. This common behavior among caretakers resulted from the difficulty in understanding what this specific data indicated or how it was estimated. As the system model did not correspond with mental models generated by users, this resulted in failure to understand how the barkpoints data on the system was calculated. Therefore, caretakers did not rely solely on this information to determine their dogs' physical activity levels. P1, P4, P5, P9, P15, P19, P20, and P22 expressed that they determined their dogs' activity limits by observing their behavior or based on the distance data rather than barkpoints.

It was even harder for users to understand certain types of data, such as the health index, due to the lack of transparency regarding how it is calculated. Thus, the difficulty caretakers face in understanding what data means or how it is calculated acted as a barrier to meaningful reflection and effective sensemaking. Moreover, this difficulty encountered in the sensemaking stage also caused a loss of trust in the data for users, which acted as a motivation breaker for the long-term adoption of the device.

6.3.2 Contextualization of the Data

One of the most prominent ways of sensemaking among caretakers is through the contextualization of the data. They understood and interpreted the monitoring data within its related context and looked for factors influencing it. For example, they made sense of the tracking data by combining it with its affecting factors, such as relating the decrease in the dog's sleep quality data during a certain period with weather conditions, considering that the dog might be disturbed by rain or hot weather and became restless at night. Relatedly, P8, P11, P12, P18, and P28 expressed their desire to view different data types for improved contextualization and better reflection, such as monitoring heart rate to evaluate the effectiveness of physical activity or to keep track of existing health issues. Another reason for the desire to monitor heart rate (P8, P11, and P12) and body temperature (P11 and P21) was the interest in understanding the dogs' affective states better. Furthermore, P14 articulated their need to view more location-based and seasonal data related to other dogs for better contextualization of the tracking data and meaningful comparison, as the physical activity and nutritional needs change based on these factors.

Another way to make sense through contextualization is by interpreting the changes in the data patterns based on various contextual factors, such as explaining a decrease in sleep quality due to increased exercise intensity on a certain day or because of barking dogs outside.

> *"[P29] I checked his quality of sleep by looking at the weekly reports. For example, it shows 86%. Another week it was 92%. So, I observed that on the days when he exercised too much, his sleep quality decreased. Because he was probably very tired, maybe he was in pain or something. Just like our legs hurt after an intense exercise, that's why it decreased. Other than that, I*

interpreted it like this. For example, some nights, maybe he heard dogs barking outside. He woke up, got agitated, stayed alert, and didn't sleep as well as normally. So, I thought about these two things, but I really saw that the quality of sleep decreased after too much exercise."

In addition to the different sensemaking strategies, P15 and P30 also experimented with data by making small changes in their daily routines to see how it impacted the dogs' sleep quality, such as by changing the placement of the dog's bed. Moreover, this tracking data helped caretakers comprehend the impact of their lifestyle and behaviors on the dog's sleep quality and behavior in general. For instance, it informed caretakers about their dogs' daily activity and sleep patterns and raised awareness of the factors affecting their sleep quality, such as the caretaker's daily schedule or the presence of visitors at home.

"[P12] We observed that our dog's sleep quality decreased by 20% on days when my husband and I stayed awake until late at night. We decided to move our fights earlier in the day [told in a sarcastic tone]."

Also, caretakers made sense of the unexpected changes in the data patterns again by contextualizing it, such as relating higher barkpoints gathered indoors to the dog's restlessness due to hot weather. Interpreting the dog behavior by activity scores was another common behavior. For example, if the barkpoints data was above a certain number at night, P29 interpreted that the dog presumably moved to another room judging by her increased activity. In cases when there was more than one dog in a participant's home (P8, P18, P30), tracking one dog's data helped with the interpretation of the other dog's behaviors based on the activity scores.

"[P18] If one of my dogs is moving, the other one (the tracked one) is definitely getting active. Because he's either trying to escape from her or changing his location. So, we understood that my other dog does not move much when we are away from home. We made such an interpretation from this [barkpoints] information."

Tracking data also supported caretakers in the decision-making about the dog's affective states around other dogs in certain cases. For example, when the caretaker was on vacation and left the dog in a pet hotel, they could make a judgment on the dog's discomfort around other dogs based on the disruptions in the sleep quality data patterns. This information helped them to make the decision to change the hotel for the next time.

> *"[P6] In the pet hotel where I left my dog, the system is like this, there are rooms, not cages, and the dogs stay in the rooms. Now, such a system is better for dog owners than a cage because knowing that your dog is in a cage makes you feel uneasy. It seems like a cage is actually not something we prefer. My dog never has any problems with other dogs. She does not attack or bark. You know, put her in a cage with a hundred other dogs, and she would stay calm. But I always wondered if she could sleep at night because she doesn't like too much physical contact. If a dog gets too close to him, she runs away. After returning from vacation, I connected to the device to see the past tracking data. I realized that my dog didn't sleep all night. I mean, there was really no sleep mode for twenty-four hours. And I was like, why didn't my dog get any sleep? There were probably four or five dogs together in the room. That's why my dog couldn't fall into a deep sleep because she was uneasy about it. She was always on guard. For example, I saw videos of her sitting or lying on the side while the other dogs were running around. I thought she was probably tired and resting, but it turned out she didn't sleep at all. That's why she idled himself like that and was just resting. And after seeing that, I realized that if I leave my dog in a pet hotel with a cage system, I am sure she will feel safer in that cage and will sleep much more comfortably at night. Even now, we are on vacation. I left her at a friend's pet hotel in the city again. I said to them, "Please, keep my dog in a cage in the room because she can't sleep when the other dogs are around." The device provided me with such information."*

Furthermore, P4, P6, P9, P11, P16, P18, P20, P23, and P30 decided on the feeding amount by combining different data types, such as burned calories and the weather temperature, and adjusted it according to these factors.

6.3.3 Sensemaking through Comparison with Other Dogs

Sensemaking through comparison stands out as an essential theme within the sensemaking of tracking data. It is seen that most caretakers tend to make sense of the data by comparing their dogs to similar dogs. Similarly, they evaluate their dogs' well-being status by comparing their data to other dogs shown on the app (Figure 6.3). For example, if the dog's activity points are close to similar dogs' average points, they can decide that the dog's exercise needs are met. Moreover, P8, P14, and

P15 expressed their desire to compare their dogs to others in the nearby location or the same country for a more context-relevant comparison.

> *"[P14] So this is statistical data that is shown here. I mean, for example, I need to see the data like this, Golden retrievers have the following average in August in Turkey. Even if there are fifty people using this product here in this region, I should be able to get statistical data from there. After all, we don't live in Canada. In Canada, dog owners can feed their dogs a more protein-based diet. A dog might need it in cold weather to keep itself warm with that protein. We don't feed our dogs so much protein-based food here. What will that animal do with so much protein in such heat here? It can damage the liver. Therefore, I need to see a geography-based comparison. The season is not the same everywhere in the World anyway. Therefore, I need to see the data on a seasonal basis so that I can take action accordingly."*

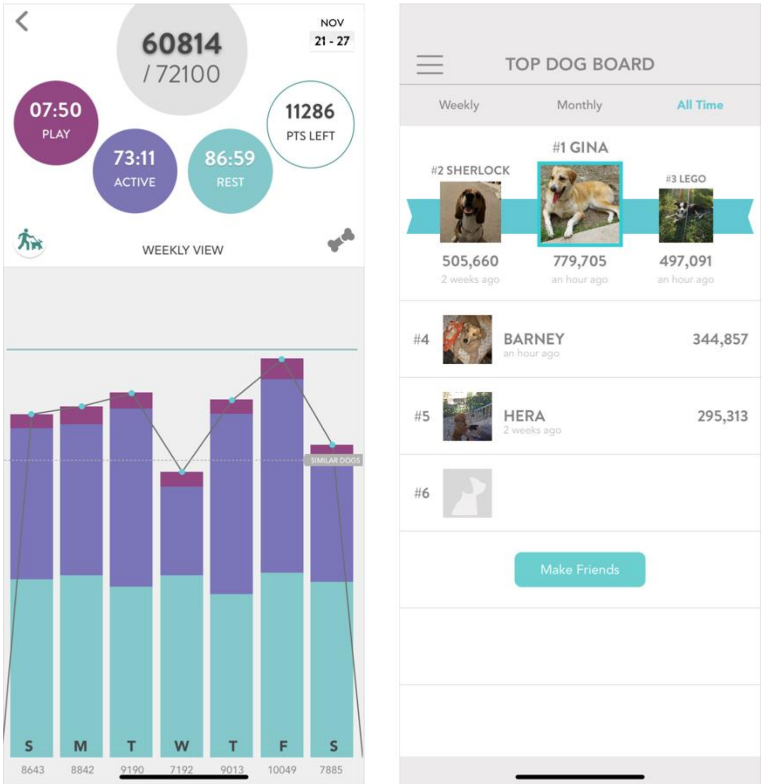


Figure 6.3. Weekly view of data chart (on the left), top dog board (on the right).

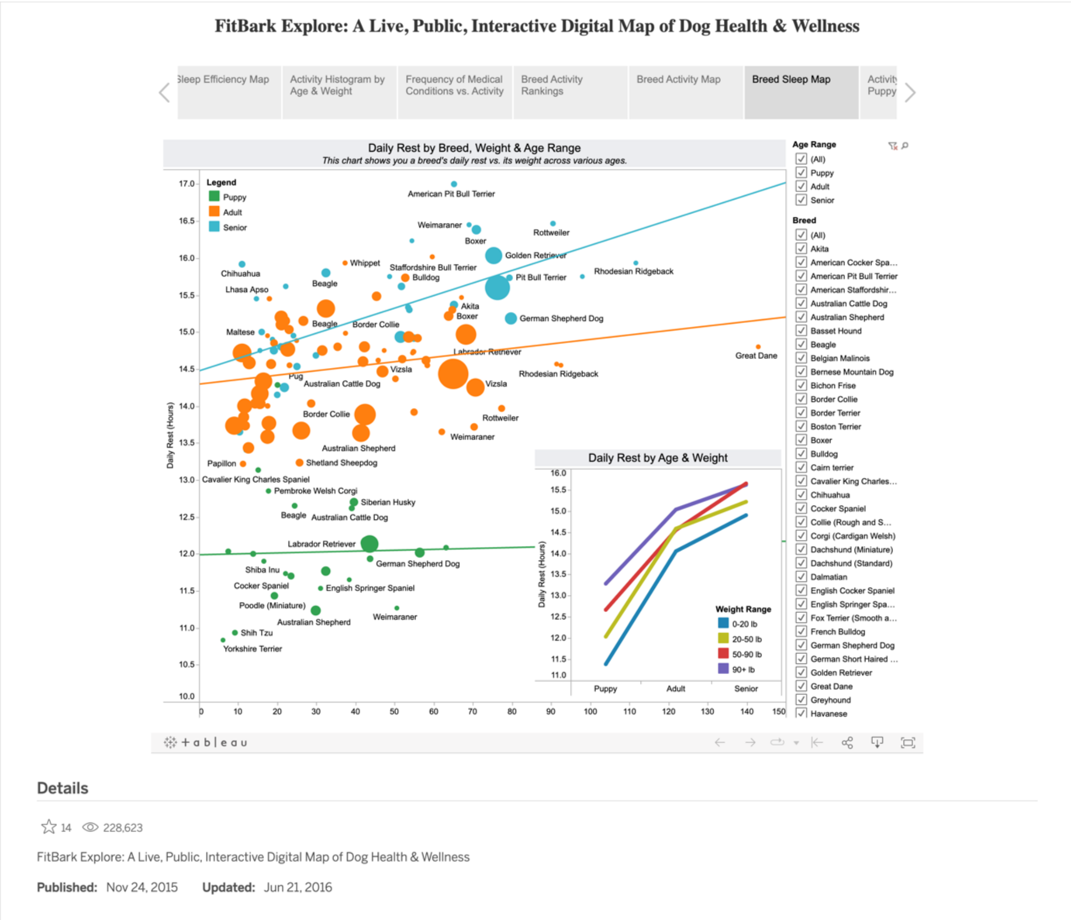


Figure 6.4. Interactive data map of the daily rest levels of dogs registered in the Fitbark database (retrieved from https://public.tableau.com/app/profile/fitbark/viz/shared/KYMHPQ26B).

Although more detailed data regarding the average levels of dogs for different data types based on dog age, breed, and weight, such as daily activity, sleep, and rest levels, is available on the Fitbark website (Figure 6.4), it is not provided on the app itself. Caretakers also tend to evaluate their dogs' overall well-being status in comparison to other dogs' averages by comparing the same data types, such as activity scores, sleep quality, and health index. Some also interpret their dogs' activity data by comparing it to their own tracking data. However, P4 and P23 expressed a need for getting more detailed reports on the average scores of other dogs for a better comparison and because this data changed over time based on factors such as climate, season, and dog age.

"[P23] At the beginning, I was wondering what the average scores for my dog were according to its breed and age. I explored the app a lot in the first weeks, especially to see whether he was normal. I was curious about which countries have which breeds of dogs and how they live. I wondered where my dog ranked among them. The app doesn't show these in detail. But on Fitbark's own website, they share all the statistics. There are detailed statistics showing how active the dogs are based on country, age range, and breed. I examined these infographics a lot. It would be better to see them on the app as well. After I made sure that my dog was in a better-than-average condition compared to the average levels, I didn't bother to check this detailed information anymore."

6.3.4 Sensemaking through Comparison with Familiar Patterns

Caretakers' current mental models and familiarity with the provided data type are essential factors affecting how they make sense of data. It is seen that P1, P2, P5, P19, and P22 tend to make sense of the data by comparing them to the metrics familiar to them, such as comparing the dog's barkpoints to their own step count data. Furthermore, P5 established a relation between their dogs' walking distance and their own, which was perceived as a more comprehensible data type than barkpoints. She also compared comparing the barkpoints scores with the personal step count she tracked on her smartphone to set a correlation between them and understand how many step count equals one barkpoint (the dog's activity score).

"[P5] I can already see the distance I walk on the map (on my phone) and guess how much we walk. But with this app, I was able to see the exact distance I walked with my dog. I could see the distance he walks and estimate how many steps [barkpoints] he takes in a certain distance. I looked at the number of steps to calculate that if he takes this many steps in a kilometer, then if I walk around here, he will take this many steps."

Caretakers also judged the effectiveness of physical activity based on the activity duration, distance, burned calories data, or a combination of these. Thus, they often preferred to focus on a particular data type that best fitted their existing mental models.

"[P23] I mean, to be honest, since he is a dog, he cannot express his problems. Somehow, he does, but he can't verbalize them. Is he tired, or has

he played enough? Or we feed him; we know how many calories that food is, but we do not know how much he burns. How hungry does he get? Are those calories really enough for him? Or how does he compare to other dogs? I looked at where he ranks among other dogs of his weight and breed, also in terms of rest time or playtime. I didn't really focus on the barkpoints score too much. I never looked at the distance, for example. In general, if I were to evaluate between these, maybe I can say that I looked more at the duration of physical activity and play. In the beginning, I often checked burned calories information, but the number of calories he spent stayed more or less the same in general. The amount of food we fed was the same. When the burned calories increased, I increased the amount of food accordingly."

The data type that caretakers mainly focus on in the system is seen to be related to various factors such as their mental models, past experiences, personas, and their dogs' characteristics (age, weight, and existing health or behavior issues). For example, P5, P7, P22, and P26 preferred not to focus too much on the burned calories, as they did not have many concerns regarding their dogs' weight. Besides, P2 perceived the sleep quality, activity, and health index data as important health/welfare indicators, thus concentrating solely on this information in the system to evaluate her dogs' health status.

"[P2] I think the thing is, in terms of monitoring his (skin) condition, the health index, and those three indices (health index, sleep quality, and playtime) made me interested. I mean, he sleeps well. He is in good health. He is active, you know, that's how we check on children, so I probably paid more attention to these. And that always kept me from worrying."

6.3.5 Social / Collaborative Sensemaking

Another noteworthy theme under this category is social sensemaking. P1, P2, P3, P18, and P25 expressed their desire to connect with the caretakers nearby to compare their dogs' tracking data with others and exchange more context-relevant experiences and know-how.

"[P1] As I said, for example, if people used it in my immediate surroundings, I could easily meet just from the application and exchange knowledge. For example, we go to the park, and my dog doesn't necessarily get along with every dog. If your dogs don't get along, you generally don't communicate much with other dog owners. But even if the dogs don't get along with each

> *other, you can still contact someone through the Fitbark app and exchange ideas about dog care or anything. So, it would be nice if there could be a community between dog owners, even if the dogs don't meet."*

P3 also joined Fitbark's Facebook group to learn more from other dog parents worldwide related to tracking data as a community with the same concerns, to find quick answers to questions, and to learn more from others' stories.

> *"[P3] Sometimes it's easier to ask questions directly to people than the company. For example, I couldn't get this to work. What should I do? There is also such an interaction. I didn't share any questions there (on the Facebook group), but for example, I listened to other people's stories. Here you are gathering with people who have similar concerns. Ultimately, that common point connects you to each other as a community through that small device. There is such a benefit for me from the Facebook group."*

However, although there was a feature to connect with and follow the nearby dogs (discover friends), along with the top dog board and sending pack requests on the system (Figure 6.4), the dogs in the nearby locations did not show on the app, and only the ones located in the US and the UK were listed. Thus, this feature could not be effectively used by participants, and they expressed facing difficulty in socializing/connecting with nearby dogs or caretakers via the app. Moreover, to satisfy their needs to connect with other dog parents, P20, P21, and P28 stated that they had already formed private chat groups with other caretakers where they exchange their experiences about dog care, learn from each other, and organize play dates for their dogs. In line with the desire for socialization, P15 and P28 stated that they expected the app to have social media integration for increased engagement. As these participants already had separate social media accounts for their dogs, they were eager to connect these accounts to the Fitbark app to share their achievements. On the other hand, the fact that the app allowed inviting multiple users to a dog profile and enabled collaborative use and tracking of the data in the case that multiple people shared caring responsibilities in a household was regarded as a positive aspect of the system.

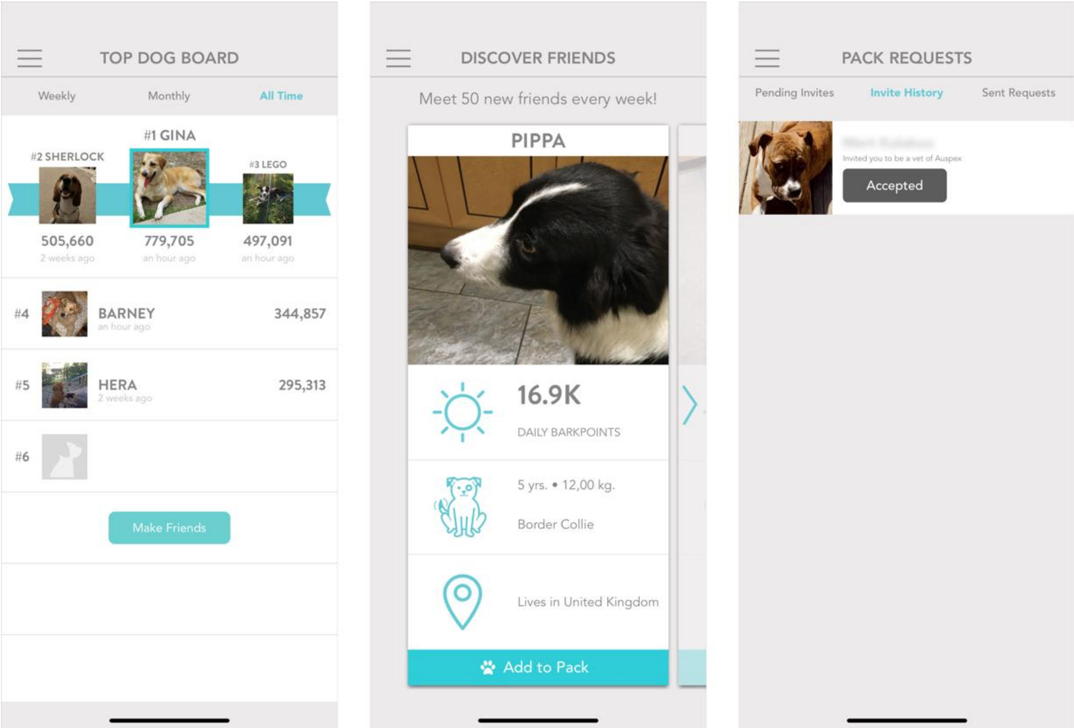


Figure 6.5. Top dog board, discover friends, and pack request features on the app.

6.3.6 Sensemaking with the Assistance of Data Visualizations

Despite the confusion about what certain data indicates, most participants expressed their preference for viewing visually represented data rather than plain numbers due to the ease of understanding it. Besides, after a particular time of use, most of them stated that they memorized the color coding on the data graphs (Figure 6.5) and tracked their dogs' daily performance just by looking at them.

> *"[P30] I also looked at it (daily data graph), and they already indicated the thing with colors, I mean, he is active at this time. Purple color indicates the active time, or blue means he was resting. You know, after a certain period of time, I had already memorized the colors, I was just looking at the color and quitting the app, frankly."*

However, presenting the data in a visual way resulted in users' increased attention to this type of data rather than to other information presented in numbers, such as the health index. P23 stated that she found the data visualization used on the data graphs to be misleading (Figure 6.5), as it fell short of depicting minor changes in the data.

> *"[P23] I think the colorings there (on the daily activity graph) are a bit misleading. For example, I go into the purple color (active). I see something like twenty-nine minutes rest and thirty-one minutes active. That's why it's purple. Then, I view the next hour. That one is blue (resting), but there's only one minute difference between them. So, it confused me. They can be shown with a mixture of colors because there is only a slight difference. For example, I looked at here (the graph) and thought about why my dog did not sit down for a minute here by just looking at the colors on the graph. But he had taken a break for half an hour every hour."*

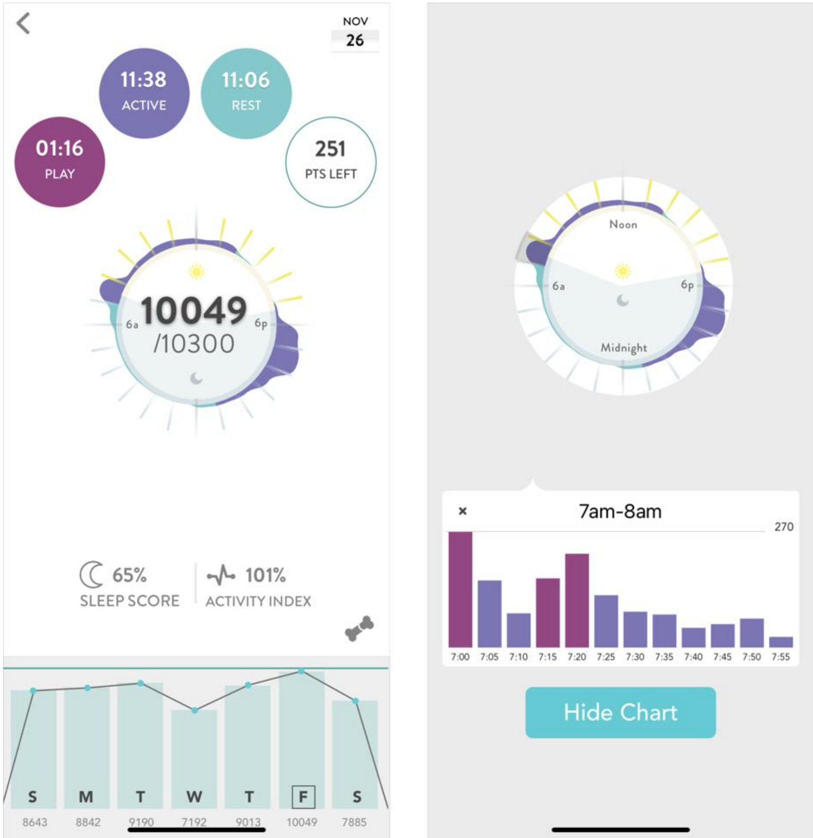


Figure 6.6. Daily activity graph.

Table 6.7. Codes and sub-codes related to reflection.

REFLECTION	
Codes	**Sub-Codes**
Checking on discrepancies	Lack of trust to the monitoring data as it doesn't change over time Perceived low data accuracy as compared to dog's observed activity / play / sleep Consistency of the monitoring data with the dog's observed physical activity / sleep levels Making sense of the tracking activity data through comparing it to one's own
Guidance for reflection	Lack of guidance for improving caregiving Need for guidance about the average levels / normal of similar dogs Need for guidance / better suggestions about how to improve the dog's current problems Desire for improved guidance for the caretaker based on the data Need for guidance about the approximate points to be gained from each suggestion/activity Desire to have more personalized/contextualized notifications
Selective attribution / focus	Focusing on the particular information on the app based on existing concerns Focusing on a certain type of data due to its prominence on the UI Focusing on a certain type of data due to its perceived trustworthiness in terms of accuracy Losing attention to a certain type of data if scores are always high Focusing on a certain type of data due to its perceived usefulness
Data handling	Establishing a relationship between sleep and activity levels Making sense of the tracking activity data through comparing it to one's own Establishing a relation between carer's own activity and dog's activity levels Losing interest in the monitoring data due to the consistency / predictability of dog's scores Interpreting both dog's tracking data together - in comparison to each other
Tracking trends in the data	Desire to set weekly goals Making decisions by comparing daily / weekly changes on monitoring data Effort to compensate missing activity the other day based on the monitoring data Sense-making of the activity data by establishing a relation with the observed activity over time with use Making sense of the data through tracking the chances in a few days Effort to establish a consistent activity routine based on monitoring data Usefulness of storing the data history to keep track of the retrospective data Raising awareness about the dog's physical activity patterns
Self-calibration	Adjusting daily activity goals based on the dog's age Self-determining activity goals based on awareness gained by data in time Supporting decision making about meeting activity needs through play Increase in play time with other dogs based on the judgement that it provides more effective physical activity Being motivated to complete self-determined goals regarding activity data Enabling to discover the dog's physical activity limits

6.4 Reflecting on the Tracking Data

After the sensemaking stage, caretakers gain awareness regarding the issues related to their dogs and transition to the Reflection stage. Without comprehending the tracking data, it is not possible to be aware of the issues that the data indicates. The Reflection stage begins when users start to reflect on their dogs' tracking data. Difficulties encountered at this stage might deter users from exploring and understanding information about their dogs. These problems occur because of a lack of time or interest or problems in retrieving, exploring, and understanding collected information. The Reflection stage includes various dimensions; *checking on discrepancies, seeking guidance for reflection, selective attribution/focus, data handling, tracking trends in the data*, and *self-calibration*. The dimensions related to the reflection stage can be seen on the Table 6.2.

6.4.1 Checking on Discrepancies

After making sense of the tracking data, caretakers check on any discrepancies between the data and the real-world during tracking and compare the two to be able to reflect on the data. For example, they verify the consistency of the monitoring data with their dogs' observed physical activity and sleep levels to decide how reliable it is. After developing mental models for the tracking data over time through interpretation based on the dogs' observed activities at the sensemaking stage, caretakers continue to check the data's accuracy by making observations, such as comparing their observations of their dogs with the changes in the sleep quality or the rest time data.

> *"[P13] I didn't trust the rest and play time very much, to be honest. I mean, what I observed is that the app shows much less than his actual rest time. You know, maybe I wonder if it calculates the REM sleep or something, but I think it shows less than what my dog does as far as I observed."*

However, it has been seen that the perceived low data accuracy as compared to the dog's observed activity, play, and sleep levels decreased the trustworthiness of the tracking data for users. Some caretakers showed a lack of trust in the monitoring data as it did not change much over time. For example, P14 complained that the average barkpoints scores of other dogs shown on the app remained the same all the time and did not change according to variables, such as weather, which affected the trustworthiness of the tracking data. This lack of trust in data for caretakers also acted as a barrier to reflection.

> *"[P14] The activity score was important data for us. But of course, there is no difference between activity and distance, I think. They multiplied the distance by 0.93 and calculated the activity score. That is also interesting. so I just tried to keep up with the score there. I changed our goals a little bit and experimented with it. I started with six thousand two hundred because seven thousand two hundred was for very active dogs. But I thought six thousand two hundred was enough, as we were less active. But it changed from time to time. Sometimes I got very motivated and said let's make it seven thousand two hundred, and then I realized that we could not reach our goals at all. It kept saying "Sortie completed zero out of seven daily goals this week". When that happened, I lowered our daily goal again. We tried to find a middle ground. I mean, it was a bit like me playing in the sand. I looked at the data of other dogs as well, and it always says five thousand two hundred and twenty-two. I mean, I think it's absurd for me to have memorized this info. I mean, it should be a variable thing. I mean, if you show data from ten years ago, that's weird. It should be constantly updated. Because it is a seasonal thing. The app should analyze it and show it to me again. You know, it should also show the data based on the geography."*

Conversely, the consistency of the monitoring data with the dog's observed activity and sleep levels was considered a factor increasing the trustworthiness of the data.

6.4.2 Seeking Guidance for Reflection

One of the most significant barriers to reflection on the system was the lack of guidance on the average levels of specified dog breeds regarding different data types. In other words, caretakers needed more information about the average levels of similar dogs as a basis for comparison and meaningful reflection. They also needed guidance on taking action to improve their dogs' current problems. Although the app provided some suggestions for improving dogs' physical activity levels, such as tips for increasing the dog's activity in ways the caretaker had not previously thought of, and helped some caretakers become more aware of their dogs' activity needs (Figure 6.7). P9, P25, and P28 expressed a desire for more personalized suggestions based on their tracking data rather than just looking at a few metrics.

Moreover, P4 also found the burned calories data pointless as she did not know her dog’s calorie intake or how many calories he should burn in the first place. Relatedly, P3, P4, P6, and P25 expressed their desire for improved guidance about feeding, weight monitoring, and the right feeding amount specifically for their dogs for a meaningful reflection or to take action based on the data. This was a common concern among caretakers whose dogs were overweight or inclined to gain weight (P6 and P25). Thus, a general lack of guidance regarding the tracking data on the system and the difficulty in understanding how to take action on the data stood out as essential factors hindering meaningful reflection.

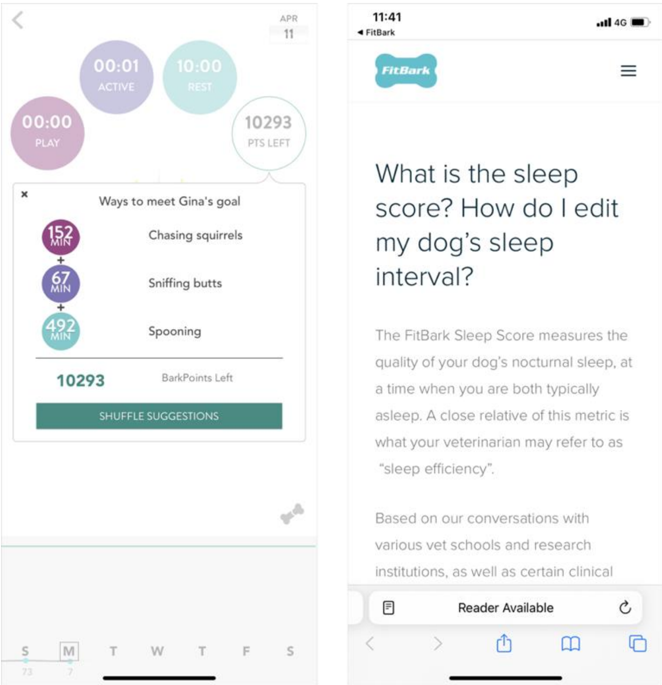


Figure 6.7. Activity suggestions on the app (on the left), informative blog posts sent via email (on the right).

6.4.3 Selective Focus

It has been seen that caretakers focus on a certain type of data on the system due to various reasons, such as their existing concerns, the perceived trustworthiness of data in terms of its accuracy, or the caretaker's familiarity with the data type. Sometimes the user's focus shifted to the data type that she was familiar with. This selective attention to the tracking data affected the usage of the system and the self-reflection process that a user went through. On the other hand, participants also lost their attention to certain types of data if scores remained consistent.

> *"[P28] I don't think this app has any guiding effect on adjusting the amount of feeding. If I search for it (the recommended amount of energy expenditure for a dog), I can find it very easily on the Internet, like she is supposed to burn this many calories. Maybe this info was also available on the app, I didn't even look at how many calories she was supposed to burn because, well, like I said. I feel like they are not very matching units. I mean, active barkpoints are directly related to the calories burned, I don't think the device measures that information correctly, the burned calorie information. Because, for one thing, does it take into account the temperature or something? For example, I thought about it recently. My dog burns more calories in the cold or in very hot weather. You know, there are some external factors. It offers an average value, and it's probably not that far off, but it's still very much like this. It was a piece of information that I ignored because I didn't think it was designed very accurately. But still, because it was visible, I had to look at it. I can remember how many calories he burned."*

It is also noticed that most caretakers focused on particular data on the app based on their existing concerns regarding their dogs, such as focusing more on burned calories if the dog is overweight or concentrating on the sleep quality data in case of any health problems. P28 also stated that he preferred just to check the barkpoints data as he considered it as a summary of all data types on the app. P2, on the other hand, perceived the sleep quality, activity, and health index data together as important health/welfare indicators, thus concentrating solely on these.

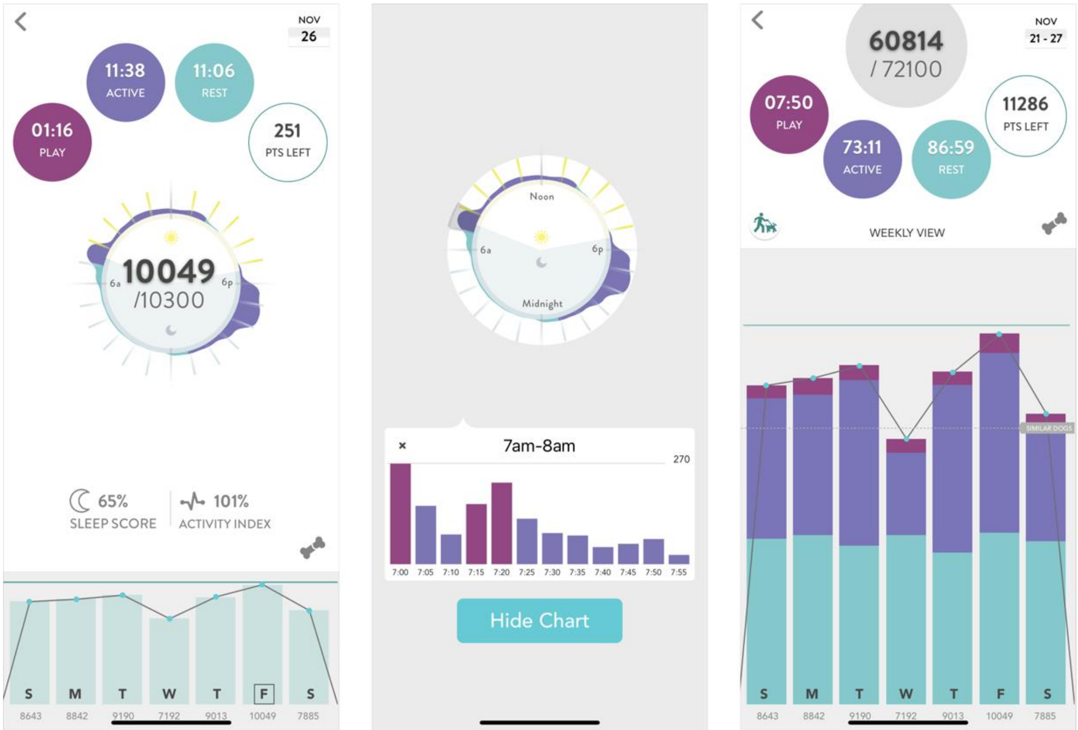


Figure 6.8. Data visualizations.

However, despite the caretaker-related factors mentioned above affecting users' attention to data, the primary driver impacting users' increased focus on specific information was the prominence of certain data types on the app UI. On the system, only a particular type of monitoring data is highlighted through data visualization, as seen on the daily activity graph (Figure 6.8). Therefore, this part attracted users' attention the most to the app UI.

Additionally, some accessibility issues on the system related to difficulty in accessing certain features on the app caused users only to utilize the type of information that was easily accessible. For instance, some features, such as weekly/monthly activity reports, were harder to navigate on the app UI and thus not utilized as often or even not discovered by some participants during the use period. Moreover, most participants expressed difficulty re-accessing a specific piece of information or a feature, such as a monthly view of the activity graph they had interacted with on the app. Some participants also had trouble understanding the functionality of certain application features, such as the journal (Figure 6.9).

Difficulty understanding the system status regarding the interactivity of specific components on the UI (i.e., activity report) was another critical issue encountered by most participants. Therefore, these system-related issues were the limitations of the Fitbark device used in the study, influencing participants' use patterns and reflection on data.

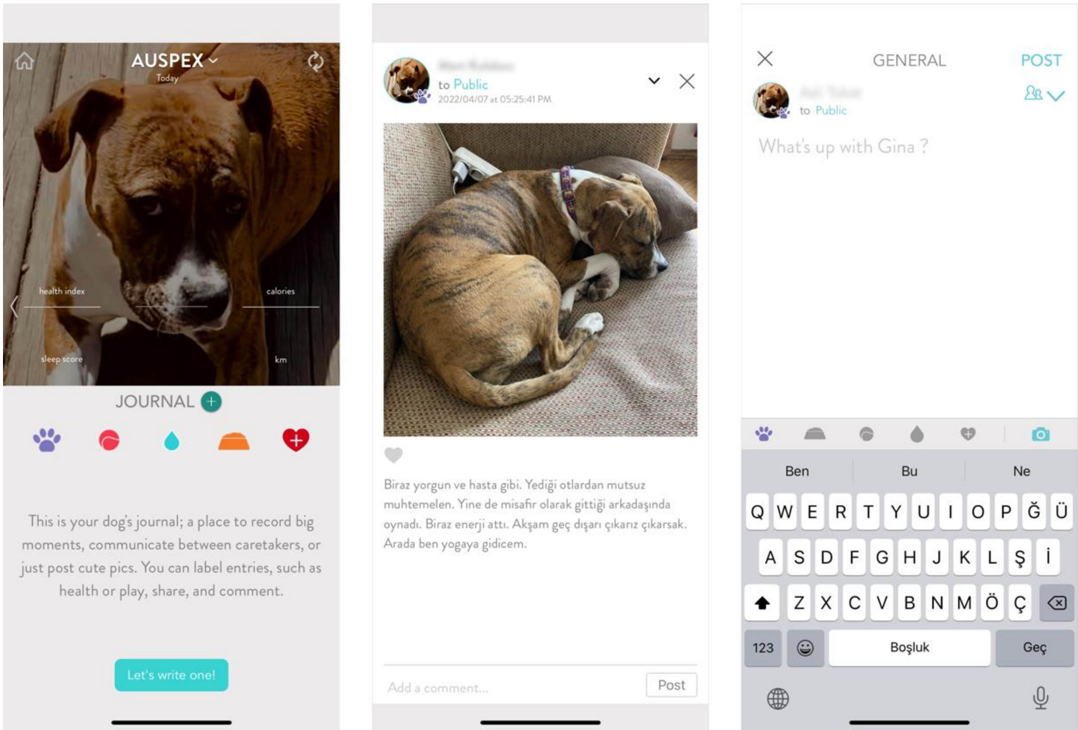


Figure 6.9. Journal feature.

6.4.4 Data Handling

The theme of data handling is related to the way caretakers deal with a large amount of tracking data on a daily basis. For example, given the variety of data types, users may pay attention only to certain types of data based on various factors to cope with the amount of information they are exposed daily. Thus, selective attention may be a way of dealing with data to manage the mental load.

Relatedly, caretakers may sometimes lose interest in certain types of monitoring data over time due to the consistency or predictability of the results. Consequently, they may focus solely on the data type that interests them, such as barkpoints. This loss of interest in data or device use, in general, may also be due to having a fixed daily routine, which leads to not noticing many changes in the data patterns. As a result, for most caretakers (26 out of 30 participants), the frequency of app use decreased towards the end of the study period, as reported in the weekly ESM surveys (Section 6.2.1 Table 6.3). During the first two weeks of the usage stage, most participants were curious about the device, which can be considered the exploration phase. They showed interest and explored most of the app's features during this period. However, this novelty effect faded over time, and they became used to different types of data in the app after the exploration phase. As users became accustomed to using the device, they became desensitized to certain kinds of data. Moreover, P25 and P28 became less concerned about the activity scores over time as they developed their strategies to set and maintain their dogs' activity levels.

> *"[P28] I already had some knowledge about how much my dog should be active before using this device. Then I enriched this knowledge a little more with the use of the app, and now I have a new understanding. More precisely, I understood how many points he would collect as he exercised. More precisely, that 14000 (barkpoints) score is our daily goal; I have made it well established in my mind and say that's enough exercise for today. Now, I can say that he played like crazy and left in 45 minutes, or I can say that he didn't play much this time, so let's stay a little longer. Now I can understand these things without looking at the app."*

This loss of the novelty effect or interest in the long term can be mainly due to the predictability of the data or the limited functionality of the device, which is also a limitation for the long-term adoption of the device. Caretakers can also interpret different data types in relation to each other, i.e., sleep quality and activity levels. For instance, they can establish assumptions by combining certain types of data during the reflection phase, such as the hypothesis that high barkpoints scores result in an increase in the sleep quality rate.

6.4.5 Tracking Trends in the Data

Participants were curious about viewing their data history and tracking trends in the data, such as inspecting data over a range of time, rather than looking at a piece of data at a short range of time. Viewing long-term data allows them to see the patterns in it and compare it from one time range with another. It is also found that patterns (whether the data is going up, going down, or remaining the same) are especially useful for users in understanding their progress toward a goal. The data history enabled them to calibrate their decisions about their dogs' physical activity and rest habits in the long run and gain awareness about their dogs' physical activity patterns. P14 and P22 expressed their need to set weekly activity goals rather than daily, as sometimes daily goals cannot be met as daily goals become unmanageable to beat every single day. Moreover, it was common among participants to make decisions by comparing daily/weekly changes in the data (Figure 6.10). For P22 and P25, it was more important to set up a consistent activity routine for their dogs in the long run or throughout the week than to achieve daily goals; therefore, they found it necessary to check on the weekly performance and the changes in it.

> *"[P22] We try to keep my dog on a regular schedule of sleep, exercise, and feeding. I guess dogs like a routine schedule. I guess they're happy that way. You know, we try to keep consistency in these aspects in the long run."*

> *"[P22] You know those weekly bar charts. There's a line there (daily goal), and sometimes his performance is above or below the line. If we were below the goal one day, we decided that let's extend our exercise duration a little bit more the next day. We usually used it to keep our routine constant."*

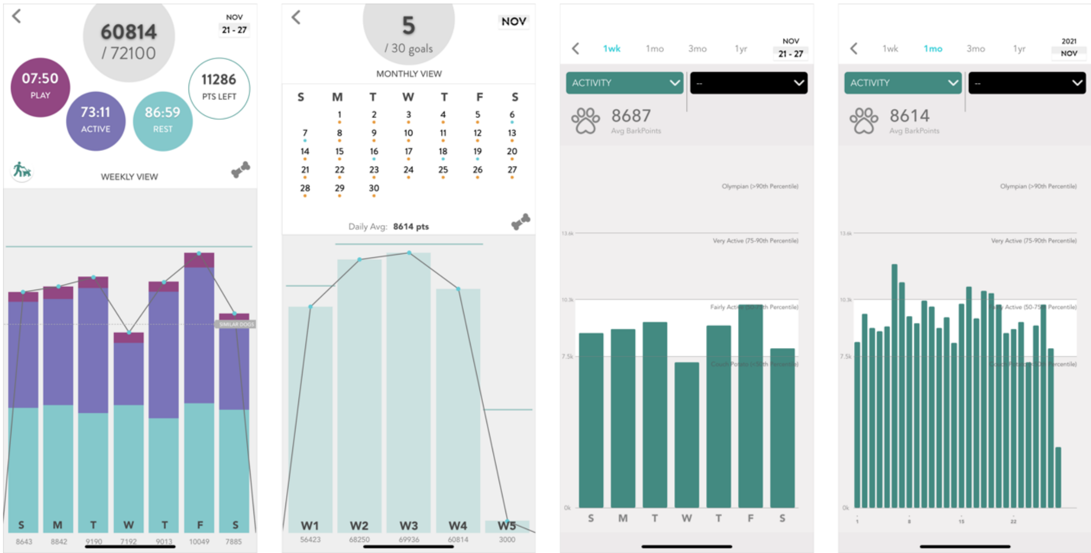


Figure 6.10. Weekly and monthly graph views.

By looking at the shifts/trends in monitoring data, P18 and P22 made an effort to compensate for missing activity the other day. However, during the exploration phase (generally the first week of the device use), it is more common among caretakers to focus more on daily changes. P17 stated that after using the device, they began to make sense of the data by tracking the changes in a few days (i.e., what barkpoints data indicates). P17 and P29 expressed that they started to understand the tracking data by relating it with the observed activity of the dogs over time since it was hard to understand what the data implied in the first few days of use. However, P20, P22, P25, and P28 also preferred to make decisions by comparing daily/weekly changes in monitoring data due to the low level of trust in the preciseness of the short-term monitoring data.

6.4.6 Self-Calibration

Self-calibration is related to the users' adjustments based on their self-reflections on data. For example, P20, P23, P24, P28, and P29 preferred to adjust their daily activity goals based on different factors, such as their dogs' age, health condition, and energy levels rather than relying on the activity goals determined by the system itself.

Moreover, they also defined activity goals based on the awareness gained by tracking data in time as the device enabled them to discover their dogs' physical activity limits. Also, P15 and P22 made changes in their dogs' activity routines by increasing their play time with other dogs based on their judgment that it provides a more effective physical activity than any other activity type. The system also allowed caretakers to calibrate their daily decisions about physical activity duration, such as deciding based on the current activity levels/scores and daily goals.

> *"[P25] There were three options in the daily (activity) goals. For example, I chose the last one, the lowest one, and even then, I was shocked because we had reached a score of 1000 only once. The lowest goal was 8500. Then I thought, no dog could have reached that score. I mean, we really can't beat that number; it's impossible. Then I lost those goals on the app. Then I tried to increase the barkpoints score of my dog by walking her more in the meantime. We were getting close to 3000 points. Then I adjusted our goal to 3500 points, but I thought I did not have to reach that goal every single day. But I would do my best. That's how I set our goal. Sometimes we scored, for example, 2800 points. Then, I was happy. There were notifications regarding barkpoints, such as 'Congratulations, your dog earned this many barkpoints today'. But let me tell you before I forget this. Do you know what it told me? It was the point that brought me down. It said that your dog had only achieved 10% of her daily goal by, say, four o'clock in the evening. That was very scary, those notifications; I mean, I received notifications like this for three or four days in a row. It was, say, five o'clock in the evening. Notifications like you've only done this until five o'clock. I mean, it was right, but I did not feel good to hear that. After that, I was worried that we couldn't accomplish it. And sometimes, there really was such a thing as being ashamed of the app. So, it threw everything in my face."*

Table 6.8. Codes and sub-codes related to behavior/action.

BEHAVIOR/ACTION	
Codes	**Sub-Codes**
Effects on lifestyle	Increase in the activity levels / Improvement in activity levels to hit the daily activity goals Increase in play time with the carer Increase in the time spent together / Increase in the time spent together through reminding carer of dog Increased rest quality on more active days as perceived by the carer Enabling caretaker to plan ahead and organize daily life according to dog's needs Organizing the daily plan around the dog's activity/rest times Enabling caretaker to include the dog in daily life scheduling Encouraging physical activity for human
Change in caregiving attitude / behavior	Enabling the carer to establish an understanding regarding the dog's needs & behaviors Enabling calibrating caretaker's decisions about activity habits / Enabling the carer calibrating decisions based on the factual data Enabling the carer making more informed decisions about daily schedule/actions due to increased awareness about effects of them on dog behavior Enabling calibrating carer's judgements about caregiving Enabling justification of the decisions on the dog's activity-rest habits Supporting decision making about balancing activity/rest Balancing activity levels/rest amount based on the data Supporting decision-making about adjusting the feeding amount Encouraging the dog to run off leash to increase the daily activity levels Supporting decision making about dog's affective states around other dogs Enabling the carer to keep the dog active by providing reminders Enabling the carer to focus on the effectiveness of the exercise Supporting decision making about meeting activity needs through play Enabling the carer to keep track of the dog's activity / rest needs during changes on daily schedule Increase in the play time due to the increase in time spent outdoors Effort to establish a consistent activity routine based on monitoring data Decrease in play interaction during outdoor exercise due to increased focus on activity goals Effort to compensate missing activity the other day based on the monitoring data Increase in play time with other dogs based on the judgement that it provides more effective activity Feeling the responsibility to increase dog's activity levels to meet the daily activity goals Increasing rest time based on the monitoring data and observed dog behavior Adjusting the feeding amount based on the data

6.5 Behavior/Action Stage

After transitioning from the Sensemaking and Reflection stages, users in the Action stage decide what to do with their new understanding of their dogs' tracking information. At this stage, users may adjust their behavior to meet their goals. The themes in this category are; *the effects on lifestyle* and *change in the caregiving approach/behavior* related to DAMS use. The dimensions related to the behavior/action stage can be seen on the Table 6.8.

6.5.1 Effects on Lifestyle

The theme, the effects on lifestyle, refers to the impact of the activity monitoring device on caretakers' and dogs' lifestyles. The most repeated effect in this theme is *the increase in the dogs' physical activity levels* through increased frequency and/or duration of the exercise or play. Caretakers generally accomplish this with a motivation to hit the daily activity goals, increase the amount of burned calories, or extend the active time. This mainly happens through the motivation provided by the daily activity goals on the app and regular notifications reminding daily goals (Figure 6.10). Most caretakers expressed that they are motivated to increase their dogs' activity levels to collect more barkpoints and hit their daily goals. For example, P15, P21, and P22 stated that they started taking their dogs out to play with other dogs to gather more barkpoints. They were also reminded to keep their dogs active by activity notifications several times every day (Figure 6.11).

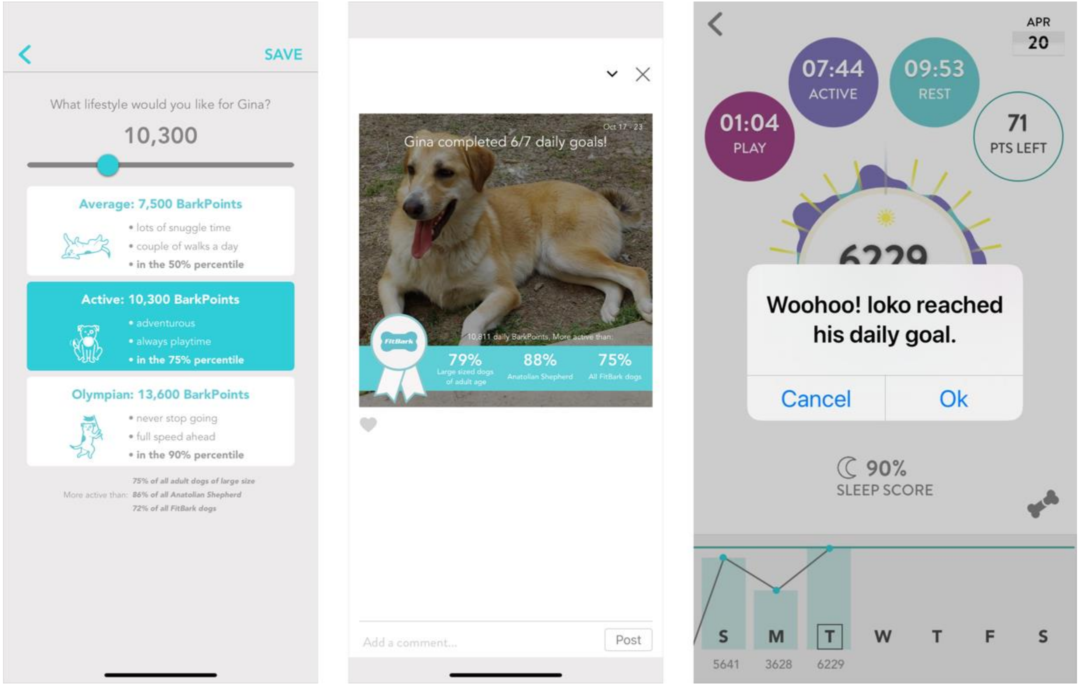


Figure 6.11. Daily activity goal settings and goal reminders.

Another common influence of the device on lifestyles is *the increase in the caretakers' play time with their dogs*. While most caretakers were encouraged to increase their dogs' physical activity levels through exercise (mostly by walking or running), the device can also support caretakers in decision-making about meeting their dogs' activity needs through play - either with other dogs or the caretaker. For example, if exercise goals cannot be completed due to bad weather conditions that day, caretakers are able to decide to reach their dogs' activity goals through play at home. As a result, it can contribute to an increase in play time between caretakers and dogs. Also, play is sometimes used as a strategy by P12, P16 and P23 to help their dogs spend their excess energy if the caretaker needs to go out or occasionally has less time for daily exercises. On the other hand, an increase in playtime can also be related to the extended time that caretakers spend outdoors with their dogs. However, conversely, in some cases (P14), it can lead to a decrease in play interaction between caretakers and dogs during outdoor exercise due to caretakers' increased focus on reaching activity goals. Additionally, rather than playing with the dogs themselves, caretakers sometimes preferred to encourage their dogs to play with other dogs related to their judgment that it provides a more effective physical activity based on the changes in the activity points data on the app.

> *"[P12] For example, some days, it rained a lot during the study period. When it rains, the duration that we can walk outside obviously decreases. On such occasions, for example, when we realized that we could not complete our barkpoints goal that day, we tried to close this gap by doing something at home by increasing the playtime. So, there is a certain time that he plays by himself, but this increases when he plays with us. That's why, if we couldn't take him outside that day or if the conditions were not suitable, we tried to compensate it by playing games at home."*

Besides, it has been seen that the play time information provided on the app leads to a *rise in the caretakers' awareness of the actual time they spend with their dogs during play*, thus motivating them to increase this duration. Therefore, both the boost in activity levels through prolonged exercise duration and/or frequency and longer play time has resulted in an increase in the time caretakers spend with their dogs.

In addition to the direct effects of device use on dogs' activity and play levels and caregiving decisions, it is also found to be useful in terms of *enabling caretakers to plan ahead and organize their daily lives around their dogs' needs*, such as planning the daily schedule according to the dog's activity and rest times and goals. Displaying dogs' activity needs as tracking data allows caretakers to include their dogs in their daily schedule. Moreover, it contributes to the increased attention of caretakers to their dogs' physical activity needs, especially when there is a change in their daily routines, i.e., on vacation. Since companion dogs' activity levels are tightly connected to caretakers' daily schedules, the data provided on the app allowed them to keep their dogs' physical activity and rest needs on track during such changes in their daily routines.

> *"[P1] I think it (the app) works as a reminder, which is a nice thing. At least you can plan your day beforehand. Well, I look there and think, for example, let's do this and that tomorrow. Now, I think it's easy to figure out how to organize my day according to my dog's needs. Because you know, you always see the data, at least as if there is proof in front of you."*

However, despite the remarkable effects of the device on most caretakers' and dogs' lifestyles, there were also cases (P5, P10, P16, P27) where it led to no considerable change in the activity and/or play frequency or duration, feeding decisions, or lifestyle in general. This was often the case if the caretaker was convinced that she was doing everything right or had no concerns regarding the dog's physical activity levels or weight, which was seen more common among the Indifferents persona explained in Chapter 5. Alternatively, it was also seen that as participants faced barriers in the Sensemaking and the Reflection stages, they failed to transition to the Action stage, resulting in no significant change in their behaviors or lifestyles.

6.5.2 Change in the Caregiving Attitude/Behavior

Another theme under the impacts category, change in caring approach/behavior, comprises sub-themes revealing how the activity monitoring device has impacted participants' caregiving attitudes and behaviors. Firstly, it has been seen that the device empowers caretakers to calibrate their decisions about their dogs' physical activity habits. For example, P3, P11, P20, and P22, expressed starting to meet their dogs' exercise needs by letting them play or run off-leash on the days when the physical activity levels fall behind on a busy daily schedule. Sometimes, it allowed caretakers to justify that the existing activity habits are sufficient to hit the daily activity goals or catch up with the average levels of similar dogs. In other words, it informed caretakers about their dogs' actual activity levels based on factual data and showed their current status compared to similar dogs.

Moreover, in addition to the increase in the activity duration and/or frequency, the device also enabled caretakers to focus on the effectiveness of the exercise. For example, P1 and P11 said they started to make an extra effort to increase their dogs' active time during outdoor exercise based on the interpretation of the distance data. For example, P1 said that he paid more attention to being active and kept moving when walking his dog outside rather than standing in the same spot for a long time. Besides, it has been seen that suggestions provided on the app helped a few participants to be more engaged with the system. For example, P1 and P15 expressed having fun following these suggestions as a means to reach their daily goals.

> *“[P1] There is an increase in the frequency and duration of me taking my dog out. (Activity) points/levels of my dog were generally very low compared to other dogs - both the general dog average and the average of similar dogs. So, I definitely made an effort to increase the duration of our walks. But there is also an increase in the frequency of our walks because the app provided me with some suggestions like ‘it’s never a wrong time to take your dog out for a walk’ or ‘it’s good for your dog to go for a walk with you anytime you can.’ It helped me set this mindset, so even if I go out for a quick break to breathe some air outside, I take her with me.”*

This increase in the activity levels is also related to the motivational aspect of the system, either by making caretakers feel the responsibility to increase their dogs’ activity levels by reminding them of their goals or feeling guilty when the daily goals are missed. Moreover, it seems that the competitiveness provided by daily activity goals, whether set by the app itself or by caretakers, was helpful in motivating them to ramp up dogs’ activity levels. The increased motivation through competition is achieved by setting daily goals and showing the average activity levels of similar dogs to caretakers as a basis for comparison. Additionally, notifications related to activity goals also add up to the motivational aspect of the device by keeping the caretakers aware of the current status of their dog's activity levels and encouraging them to be more active even with a busy schedule. P21 even expressed his desire to get more frequent notifications to be on track with his dog’s activity needs.

However, although some caretakers are being motivated by activity notifications, P25 expressed her dislike for notifications for making her worry due to the perceived negative language and her concerns over not reaching the activity goals. Being disappointed due to low activity points or even getting irritated by not achieving the activity goals is particularly prevalent among the Compassionate Parents persona. Thus, this user type tended to set and complete their self-determined activity goals due to the belief that pre-set/recommended goals on the app are unachievable or irrelevant for their dogs. The low activity levels can be related to the dog’s existing physiological or psychological condition, such as being traumatized or overweight, along with the dog’s age, breed, and individual differences. Therefore, although showing certain predefined activity goals and average levels of similar dogs has been useful for some, these might not apply to all the dogs and might worry some caretakers.

It is also seen that the device enabled caretakers to justify their decisions on their dogs’ activity-rest habits. For example, P22 and P23 expressed that they decided to increase their dogs’ rest time based on their interpretation of the monitoring data and the observed dog behavior. This justification for caregiving decisions with the help of the device and being able to see the dog’s activity needs with precise monitoring data helped them feel relieved.

> *“[P22] If, for example, we had less exercise, then I could have increased it, or if we gave him not enough food, I could definitely make a change when I see the burned calories on the app. But when I checked the data, I said yes, we are doing it right. Playtime is good, food is enough, and sleep quality is good. Well, it actually helped me to check them out. Whether there is anything to change or not. I can now actually check myself. It's helpful for me in terms of keeping things in control. It provides a nice summary of how I treat my dog rather than checking how he's doing… In other words, it made me realize the things that I could not notice by myself normally if I were doing something wrong (in terms of dog care).”*

Furthermore, the extended time spent during both activity and play with the use of the device resulted in an increase in the time that caretakers and dogs spend together. This is also possible by regularly reminding the caretaker of the dog via notifications or by checking on the app. This led to a perceived improvement in the relationship due to increased play time/interaction for P7, P8, P11, P16, P20, P23, P26, and the quality of time spent together. Moreover, the device also helped P4, P6, P11, P16, P18, P20, P23, P25, P28, and P30 adjust the feeding amount based on the monitoring data, such as based on the burned calories or the dog’s activity levels.

> *“[P20] I really couldn't decide from the very beginning whether he is full or not. I started to make my decisions according to the (activity) points. You know, today, it seems like it was much higher. I give him ten or fifteen grams more food if he's more energetic. I could do this with more peace of mind. Normally, as I say to myself, we didn't walk very far today. I’ll feed him a*

little less or more. But I am a little more comfortable now when making such decisions about feeding."

The loss of excess weight with the increased activity of dogs, improvement in dogs' physical performance as perceived by caretakers, and perceived improvement in the dogs' mood/general well-being are the other outcomes that are likely to be a consequence of the obvious impacts of the device on dogs' activity/play levels. In addition to the effects of the device on dogs' activity levels, it is seen that the device also encouraged caretakers to increase their own physical activity along with their dogs.

6.6 Implications of DAMS Use

This section presents the implications of the device use, including the sub-themes; *increase in caretakers' awareness, perceived effects on the relationship*, and *perceived effects on dog welfare*.

6.6.1 Increase in Caretakers' Awareness

The study revealed that after making sense of and reflecting on the tracking data, device use impacted caretakers' awareness in diverse ways. Firstly, it allowed raising their awareness about their dogs' physical activity levels by informing them about the current status of their dogs based on the tracking data. For example, for P5, P14, P19, P22, P28, and P30, it was useful for verifying their existing assumptions about their dogs' physical activity levels by comparing them with factual data, such as making judgments based on the barkpoints score and the daily activity goals.

"[P23] For me, for example, ten thousand barkpoints was important. When he passed the threshold of ten thousand, I knew that my dog had a quality, good time that evening. When we were not at home, and he was unhappy, even if he was standing, and not sitting, even if he was not resting, his barkpoints scores were very low. In order to earn points, for example, he needed to play or walk around. When we took her out or made her play games, her scores were very good. We knew that. Her activity also told me

> *that my dog was happy. I was neutral against her resting. But when she did not rest and stayed up and collected fewer barkpoints, for example, it was a bad sign for me. You know she had not been active. That was what I had set in my mind. I was looking at how she compares to other dogs at first, but I realized that my dog has nothing to do with the average. I mean, there are too many deltas in terms of sleep time, etc. So, I started to evaluate her within her own scores. Did she catch her average of the previous days that day? Was she above or below her own average? I tried to set a goal by looking at these, but of course, the barkpoints score also provided me with an idea."*

It also helped them to monitor and learn more about their dogs' physical activity and sleep patterns. Relatedly, it allowed caretakers to gain awareness about their dogs' activity and rest needs and enabled them to calibrate their decisions about their dogs' physical activity habits.

> *"[K5] I think this device taught me what my dog should do daily for how long, and with what quality she should do. I would like to keep the device for the rest of my life. But even if I couldn't, it helped me gain awareness. Because I always had this on my mind. Yes, I walk my dog shortly in the morning because he is not a very active dog. And even though she walks a little, she never barks during the day or doesn't try to gnaw on something. She sleeps very stably even when I'm not at home. I come in the evening, and we don't walk too much, but again at night, she doesn't cause any problems. So, I always had the impression that this is enough for my dog because they say that dogs with problems like this can't get rid of their energy, walk a little more here, extend their morning walks in the evening, so I always wonder if this is enough for her because I don't see such a problem in my dog. Obviously, I had such a concern in my mind. Now, I've seen this with this device. In fact, although little exercise does not cause a problem for an easygoing dog, there are days when it is not enough. I need to increase her activity a little more. Maybe that's why she's gaining weight. She is a little lazy herself, but it seems like I have to push her more; it (the device) actually contributed a lot to me in this sense. Now, I understand with this device, my dog needs to exercise a little more, and I need to encourage her to play more. So, it obviously provided me with consciousness."*

Besides, the device enabled caretakers to discover their dogs' activity limits, such as the maximum and minimum activity scores the dog gets based on different cases, and also develop an understanding of the optimum amount of exercise their dogs need based on factual data, such as, by looking at which point s/he gets very tired and the maximum barkpoints scores earned after a particular activity. It allowed P4, P15, P16, and P25 to discover more about their dog's exercise and play preferences. for example, P4 expressed that they did not know that their dogs actually love running. They found out about it with the device because they did not allow their dogs to run off-leash much before.

6.6.2 Perceived Effects on the Relationship

The sub-theme perceived effects on relationships can be interpreted concerning the aforementioned impacts of the device. For example, P7, P8, P11, P16, P20, and P23 reported a perceived improvement in their relationships with their dogs due to increased playtime and interaction with them through involvement in play. Relatedly, P7, P8, P11, P16, P23, and P26 stated that there had been a perceived improvement in their relationships with their dogs due to extended time spent together with the device use. Moreover, P20 also felt an increase in dogs' attention to themselves. They also felt responsible for increasing the dog's physical activity levels to meet the daily activity goals with the device. However, most caretakers stated that they observed no remarkable effect on their relationships related to device use. The results of the MDORS t-test given in Section 6.2.2 Table 6.5 support the lack of any effect of the device on the human-dog relationship.

P3 and P26 also expressed a perceived improvement in the quality of rest time with their dogs with the device use. This improvement is seen as a result of more defined resting times for dogs set within the day and an increased rest quality on more active days, as perceived by caretakers. Participants' judgment on the increase in their dogs' resting quality is generally based on their interpretation of the progress in the sleep quality data.

6.6.3 Perceived Effects on Dog Welfare

In addition to the perceived effects on the relationship, caretakers perceived various effects of device use on dog welfare. For example, P11, P16, P20, and P25 reported a perceived improvement in their dogs' existing behavioral issues, such as chewing on unwanted objects. P25 expressed an improvement in the dog's mood or general well-being, which can be related to the improvement in their physical activity and rest balance. Moreover, loss of excess weight, a perceived improvement in the dog's physical conditioning/performance, and a perceived increase in the dog's appetite were more remarkable changes observed by caretakers, all of which can be related to increased activity with the device use.

6.7 Barriers to Long-Term Adoption of DAMS

In addition to the above-mentioned themes, there are also some system qualities that affect caretakers' long-term adoption of the device, including connectivity, privacy, accuracy, and wearability.

Firstly, there were issues regarding the connectivity of the device, even when it was near the user's mobile phone. P2, P3, P4, P6, P11, P13, P16, P21, P26, and P30 reported constantly having issues connecting to Bluetooth and problems with data synchronization between the device and the companion app. Therefore, they said they frequently checked the app to see whether it was working, which relates to the connectivity of the device. Moreover, P9 also expressed his privacy-related concerns, such as sharing his dog's data with third parties via the device. Moreover, there were concerns over the accuracy of the data, especially when the collar was removed temporarily. P9 and P14 reported that the data shown on the app was inaccurately low or high when the collar/device was removed and worn again.

In addition to the connectivity and accuracy-related issues, the lack of remote-monitoring options was another concern among many caretakers. Although the device does not currently provide any real-time data tracking option, as it works on Bluetooth technology and synchronizes the data when the smartphone is near the device, it stores the data history and allows caretakers to keep track of the retrospective data whenever the caretaker is near the dog again. However, the majority of caretakers expressed their need for remote monitoring of their dogs due to various reasons, such as for monitoring existing behavioral issues and health issues, to be able to take action during any emergency, or just out of curiosity about what the dog does when left alone. Despite the fact that the device currently has no real-time monitoring feature, even providing retrospective monitoring data regarding the activity/rest levels, sleep quality, or health index might perpetuate some caretakers' existing concerns about dog behavior when left alone. For instance, P23 stated that she felt even more worried when she needed to leave her dog at home after using the device because she interpreted the low activity levels and low sleep quality data as restlessness in her dog. Thus, monitoring data should be provided with improved guidance to caretakers about how to improve the dog's current problems and the average levels of the dog for each data type/parameter - such as providing the data together with the potential explanations as to what the data means or how it can be interpreted.

Figure 6.12. Fitbark collar-mounted device (retrieved from https://www.fitbark.com/).

Lastly, as a system quality linked to the collar-mounted device (Figure 6.12), constituting a barrier to the potential impacts of the device is wearability. Although some participants found the device suitable for dog ergonomics, there were cases where it caused skin irritation/itching on the dog. P9, P14, P16, and P19 observed discomfort in the dog, such as itching, skin irritation, and hair loss around the collar area, due to the device's connection type to the collar (plastic cable ties). Moreover, for P9, P14, P19, P26, and P29, the dog's reluctance/resistance to wearing a collar for extended periods or the caretaker's concern over the dog's possible discomfort due to wearing a collar all the time constituted a barrier to using the device. Besides, P9, P16, P22, P27, and P28 also experienced problems with the device falling due to poor connection detail to the collar. Lastly, P28 stated that he was not reluctant to adopt the device for long-term use due to its lack of aesthetic appeal together with the collar. All these aspects related to the wearability of the device might also hinder its potential usefulness.

> *"[P28] I don't think I'll ever need the device again. If he had a nice collar, maybe I'd be okay. I guess I care about my dog's aesthetic quality. I don't like that collar. It's the collar that we put the device on with the collar. Maybe if I had put it on a nice collar, I think I would have been more okay. I'm happy to a certain extent that it's gone.*

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CHAPTER 7

THE MODEL OF DAMS-MEDIATED STAGE-BASED AWARENESS: DESIGN STRATEGIES

This chapter presents the stage-based DAMS-mediated awareness model, a key finding of the study. Firstly, the barriers to the sensemaking, reflection, and action stages are discussed. Relevant design strategies formulated to address these barriers with respect to different caretaker persona characteristics are then presented. The chapter concludes with a discussion of how the model can be used in the design and development of dog activity monitoring systems.

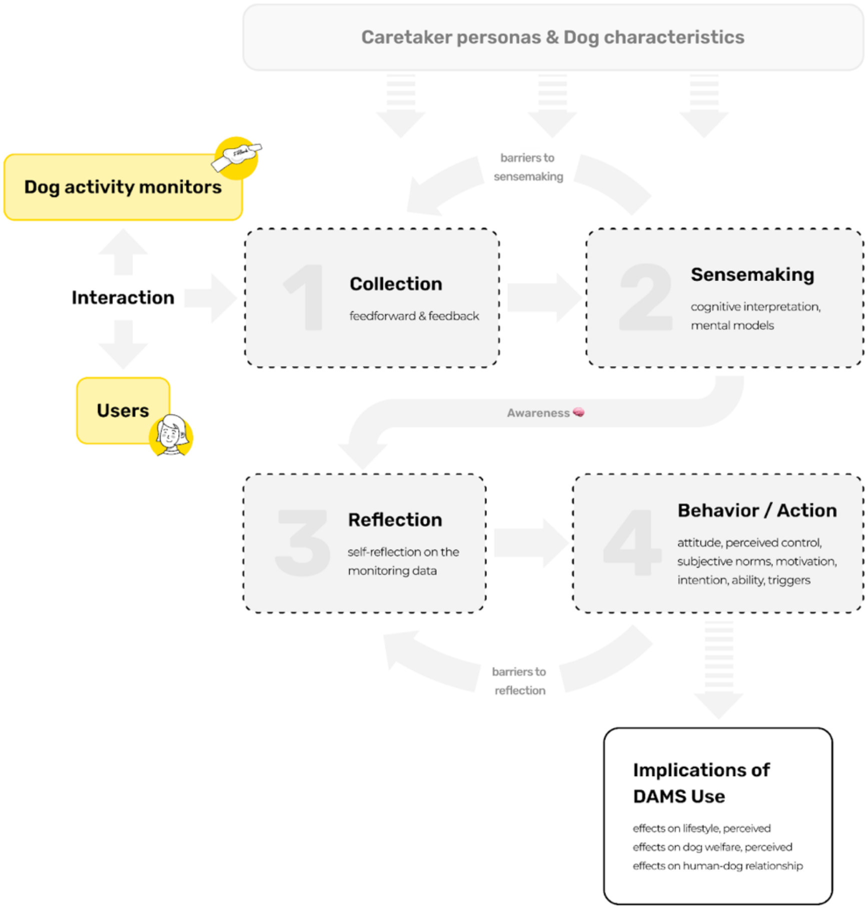

Figure 7.1. DAMS-mediated stage-based awareness model.

7.1 Design Strategies

This section presents the strategies for supporting sensemaking, reflection, and action, along with the barriers to these stages in the DAMS model (Figure 7.1). Finally, each of these strategies is explained in relation to the different information needs of the caretaker personas explained in Chapter 5. The suggested strategies are listed on the Table 7.1 along with the barriers and their related stages.

Table 7.1. Design strategies to support sensemaking, reflection, and action.

Strategies	**Barriers**	**Stage**
1. Enhancing comprehensibility of information	• Difficulty in understanding what data means/indicates • Difficulty in understanding how data is calculated	Sensemaking
2. Providing different types of data to support sensemaking	• Lack of a variety of data types to support sensemaking (i.e., heart rate to evaluate the effectiveness of the physical activity or location-based seasonal data)	Sensemaking
3. Enhancing contextualization to support meaningful reflection	• Lack of contextual data to support meaningful reflection	Reflection
4. Providing a basis for meaningful comparison	• Barriers to evaluating/making sense of data through comparing it to similar dogs - limitations in data provided for comparison between similar dogs	Sensemaking
5. Ensuring compatibility with mental models	• Limitations in the number of provided data types suitable to caretakers' mental models - familiar data types	Sensemaking
6. Visualizing the tracking data to enhance understanding	• Difficulty in understanding not visually represented data • Difficulty in interpreting data graphs • Misleading data visualization	Sensemaking
7. Showing data history to enable users to track their progress	• Difficulty in viewing long-term data/data history - accessibility issues • Limitations in defining long-term goals	Sensemaking
8. Supporting social sensemaking	• Difficulty in connecting with other caretakers nearby for social sensemaking through comparison and exchange of context-relevant experiences/know-how	Sensemaking
9. Providing guidance to support reflection	• Lack of guidance on average levels of dogs based on breed and age for each data type • Lack of guidance on how to take action on the existing issues	Reflection
10. Providing actionable feedback to support reflection	• Lack of contextual feedback - suitability of suggestions to cultural and contextual differences	Reflection
11. Providing improved personalization for meaningful reflection	• Lack of personalized feedback - according to each persona type’s concerns and dog-specific conditions/needs	Reflection
12. Enabling self-calibration through improved guidance/user engagement	• Lack of flexibility in terms of determining goals for different data types to adjust them according to different circumstances	Reflection

13. Motivating to support action	• Goals • Notifications • Competition	Action

7.1.1 Enhancing Comprehensibility of the Information

Enhancing the comprehensibility of information in dog activity monitoring systems is of vital importance at the sensemaking stage, as the difficulty in understanding the data can lead to ignoring a particular type of data or abandoning tracking altogether. Data comprehensibility on DAMS can be improved from two points onwards;

- The challenges faced in understanding the meaning of certain data, such as barkpoints, can lead to confusion among users. Thus, one approach is to inform users about what data indicates or how it should be interpreted, such as by using an info button or providing clear definitions of data metrics. For instance, research on human wearables suggests that presenting data in understandable ways can help users reflect on the tracking data (Bentvelzen, Niess, and Wozniak, 2021).
- In addition, the difficulty in comprehending how data is calculated can also lead to confusion for users. Moreover, it can reduce the trustworthiness of the data, which may lead to ignoring the data type or stopping tracking. Therefore, another approach is to make the calculation process transparent to users, which can enhance trust in the data and increase the likelihood of continued tracking. For example, in their study, Niess and Wozniak (2018) suggest that presenting information about how data is calculated can improve user understanding and trust.

The comprehensibility of tracking data is important for all user types explained in Chapter 5, as it enables the transition to the reflection and action stages, where data is transformed into meaningful insights. In the case of human fitness trackers, studies have shown that the ability to understand and reflect on the data is crucial for behavior change and long-term adherence (Kersten-van Dijk et al., 2017). Similarly, in dog activity monitoring systems, providing users with clear and comprehensive information about data can support reflection and action, leading to improved caregiving practices. Besides, research on personal informatics systems suggests that providing a clear picture of how the system works and processes data can support users in developing a coherent mental model of the system (Yang et al., 2015).

7.1.2 Providing Data Variety to Support Sensemaking

One barrier to sensemaking for caretakers is the limitation in the variety of data types on the systems. For example, Fitbark only provides barkpoints, along with active time and playtime, as the only indicator of dogs' physical activity. However, caretakers can evaluate the effectiveness of their dogs' physical activity or the meaning of the barkpoint score based on distance or burned calories data, which are the data types that fit better to their mental models or are more familiar to them. This type of sensemaking can be further supported by providing different types of data, such as heart rate, body temperature, or average scores of similar dogs based on season and location, to help interpret the changes in the data. Research on human fitness trackers suggests that providing different types of relevant data related to the time of tracking can help users interpret changes in the data and improve sensemaking (Li et al., 2011).

Moreover, most caretakers tend to establish relationships between different types of data during the sensemaking phase. For example, they may interpret the changes in sleep quality through barkpoints or relate their own step count or distance, which they track via their smartwatches or smartphones, to their dogs' barkpoint scores. Thus, another strategy can be highlighting the relationship between these potentially related data types through data graphs to support sensemaking.

Providing a variety of data types on DAMS can be particularly advantageous for user types who are more inclined to self-reflect, such as Info Geeks, Physical Activity Supporters, and Attentive Health Guards. For example, Info Geeks need to access more information about their dogs’ welfare. They are also eager to log additional information related to their dogs to track any changes in their health and well-being. Therefore, providing contextual and detailed insights about dogs via these devices might be a strategy aligned with Info Geeks’ information needs and their will to self-reflect on the data. On the other hand, Attentive Health Guards specifically need to learn about the calorie intake of their dogs to control their weight and to balance their physical activity and feeding levels based on different variables. Thus, providing them with more information about their dogs' calorie intake and activity needs, as well as information on the appropriate feeding amount based on variables such as activity level and climate, would be more likely to contribute to their caregiving quality by addressing their concerns and information needs via these systems. In contrast, Physical Activity Supporters require accurate information on their dogs’ exercise needs based on factors such as breed, age, and health condition.

All in all, activity monitoring systems for dogs should offer a variety of data types and highlight the relationships between potentially related data types to enhance sensemaking. This approach will enable users to comprehend the meaning of the data and support them in their caregiving practices.

7.1.3 Ensuring Compatibility with Mental Models

New data types offered on the system, such as barkpoints and health index on Fitbark, do not make sense to most users because they do not understand what these data types mean or how they are calculated. As a result, they interpret them by establishing a relationship between more familiar data types, such as distance and calories burned, which they use to track their individual fitness trackers. The limitation in the number of provided data types that match the caretakers' mental models or familiar data types is found to be a barrier to sensemaking. Therefore, either these data types should be better named to convey their meaning or more information should be provided about what they indicate to sensitize caretakers to these new data types.

Ensuring that tracking data aligns with users' mental models is a strategy that applies to all caretaker personas, as the comprehensibility of information is a system-related limitation that can act as a barrier to sensemaking for all types of users. The importance of providing users with data types that match their mental models or existing knowledge is widely recognized in the HCI literature. For example, the mental model theory proposes that users develop mental models based on their existing knowledge and experience, which they use to interpret and make sense of new information (Johnson-Laird, 1983). Therefore, understanding the users' needs and expectations of dog tracking data and supporting them in developing mental models of the data and system can facilitate sensemaking. This can also help users to attain the desired value from DAMS to improve their caregiving.

7.1.4 Enhancing Contextualization to Support Meaningful Reflection

Caretakers are mostly curious about the other things happening at or near the same time as their current information-seeking content. Therefore, the lack of contextual data constitutes a barrier to meaningful reflection for caretakers. Providing more contextual information, such as changes in the weather, temperature, humidity, noise levels, food consumption, or calorie intake, can help caretakers interpret the tracking data and the changes in it in relation to the affecting contextual factors. For example, it is important to know how a dog's physical activity and food consumption affect her weight because by knowing these factors, caretakers can act on those factors to change their caregiving behaviors regarding feeding and exercise. Moreover, even if the Fitbark system does not provide any remote monitoring option, collecting additional and relevant contextual data would also help caretakers make sense of their dogs' overall well-being better, especially when they are away.

Providing contextual data to support reflection can be particularly beneficial for user types who are more willing to self-reflect and interpret the behaviors of their dogs, such as Info Geeks, Responsible Caretakers, Attentive Health Guards, and Compassionate Parents. For instance, Info Geeks can benefit from contextually relevant data to satisfy their detailed information needs about their dogs during the sensemaking and reflection stages. Additionally, Responsible Caretakers need information on their dogs' overall well-being when left alone, often through remote monitoring. This need can be addressed by supplementing the activity monitoring data with contextual data related to what is happening at the time of tracking so that they can better interpret the welfare state of their dogs. Including relevant contextual data can also provide a more comprehensive understanding of the caretaker's dog and the environment in which they live. On the other hand, Compassionate Parents need a better understanding of their dogs' affective states and behaviors. Therefore, providing them with additional information to help them interpret their dog's behaviors would be aligned with their information needs.

Providing contextual data is crucial to improving the usefulness and reliability of activity monitoring systems for dogs. By offering caretakers more contextual information, they can interpret tracking data more effectively and make more informed decisions about their dogs' health and well-being. Research has shown that providing contextual information via personal fitness trackers improves users' self-reflection on their personal data (Li, 2011). Furthermore, the provision of contextual data helps users to understand the meaning of the data and supports them in their caregiving practices.

7.1.5 Providing a Basis for Meaningful Comparison

Another barrier to making sense of the data is the lack of ways in the system to compare tracking data with similar dogs. On the Fitbark app, only average barkpoint scores of dogs of similar age and breed are shown on data graphs, but no information is provided for averages related to other types of data, such as sleep quality, calories burned, or health index. This lack of reference to the averages of other dogs is a barrier to reflection, as caretakers often seek this information to check how well their dogs are doing compared to other dogs. Without knowing the normative data within a specific data category, providing only the tracking data can be pointless for users.

Due to the lack of such information, caretakers tend to compare their dogs within themselves over the long term, such as comparing the data at different time frames to see the trends in the data. However, they still lack knowledge regarding the suggested levels/scores for their dogs in each data type.

There is also a dog leaderboard that allows comparison to other dogs and creates a sense of competition for caretakers, but it only shows dogs in the US and UK because that is where the majority of Fitbark users are located. However, the context differs by location due to various factors such as cultural and lifestyle differences. For example, the lifestyle of a caretaker and their dog, and their access to large areas for exercise, may be very different from their counterparts in Turkey. Therefore, such comparisons may be more meaningful if they are based on location and allow comparison of dogs in nearby locations.

7.1.6 Visualizing the Tracking Data to Enhance Understanding

Users often find it easier to understand visually represented data than simple metrics. Visually displaying personal data (Consolvo et al., 2008a; Consolvo et al., 2008b) is a design strategy frequently used in personal informatics systems to motivate users. These visualizations can help users better understand the data by making it easier to see patterns and changes over time. They become familiar with these graphs over time and understand the changes in the data simply by looking at the charts. Therefore, tracking data should be presented through visualizations as much as possible to aid in sensemaking. However, these graphs should be better designed so that they do not hide subtle differences or make them easier to read.

Visualizing the tracking data to support understanding is relevant for all caretaker personas. However, tailoring the type of information to be presented in graphics is important to address their varying information needs regarding their dogs. For example, Info Geeks may prefer more detailed visualizations with a lot of information, while Compassionate Parents may prefer simpler visualizations that focus more on emotional states and behavior. By tailoring the type of information presented in graphics to different user types, designers can ensure that their visualizations are most effective in aiding sensemaking for their users.

7.1.7 Showing Data History to Enable Users to Track Their Progress

Being able to view data history is essential for caretakers to understand patterns in data and how they affect their dogs' progress in the long run. However, difficulty viewing data history can make it harder for caretakers to track their dogs' progress over time, such as understanding whether their dogs are maintaining their physical activity levels or not. For example, many caretakers in the study had difficulty viewing their data history on the Fitbark app due to accessibility issues with the user interface. The weekly or monthly data graphs on the app were difficult to navigate, which hindered caretakers from tracking trends in the data and their dogs' long-term progress. Additionally, caretakers were only able to set daily goals on Fitbark and not any longer-term activity goals, such as weekly or monthly goals.

Caretakers were interested in viewing longer-term goals to achieve a consistent physical activity routine for their dogs instead of just hitting short-term or daily goals, as mentioned in Chapter 6. Following these trends and patterns in the data allows caretakers to identify factors affecting their dogs' welfare and certain behaviors, such as the relationship between decreasing sleep quality and lifestyle or increased physical activity and weight. However, difficulty in accessing data history or setting only short-term goals hinders caretakers' ability to reflect on the data and also prevents the long-term adoption of the device. Research on human fitness trackers shows that providing data history allows user to compare their progress toward a certain goal over the long term (Li et al., 2011).

7.1.8 Supporting Social Sensemaking

One common behavior and essential theme among caretakers when interpreting their dogs' tracking data is social sensemaking. Social sensemaking can be referred to the collaborative understanding through sharing and comparing tracking data among users and exchanging context-relevant experiences and know-how. Although the Fitbark device did not allow users to connect with other dogs or caretakers nearby due to location-related issues, social sensemaking emerged as a theme as most caretakers expressed a need for it. For example, two study participants who lived in the same neighborhood met each other during their daily walks and discussed their dogs' scores and activity levels. Some also connected via other online platforms, such as private chat groups with other caretakers, and formed communities for knowledge exchange about dog care and to schedule play dates for their dogs.

Thus, the difficulty in connecting with caretakers nearby acted as a barrier to social sensemaking. Providing social networking opportunities for sharing dog tracking data with each other can be a good strategy to support social sensemaking, such as sharing and comparing dogs' scores. Being able to compare data in the context of others might lead to a better understanding by providing a connection between real-life events and interactions with others, such as learning what others do to increase their dogs' barkpoint scores.

Social motivation strategies might be utilized, particularly for Social Butterflies, to support their caregiving. Social Butterflies are the user type more inclined to learn from each other and to exchange knowledge among caretakers on dog care, as explained in detail in Chapter 2. The use of technology to motivate behavior change emphasizes its social role, as described in persuasive technology strategies (Fogg, 2003). Effective design strategies for computerized systems include enabling social learning, comparison, facilitation, cooperation, and competition among users (Oinas-Kukkonen & Harjumaa, 2008). Moreover, giving credit, social influence, and providing personal awareness (Consolvo et al., 2006) are other behavior change techniques frequently used in activity tracking systems. Besides, research on human personal informatics systems suggests that social sensemaking through social networking and sharing of personal tracking data can support users in making sense of their data (Puussaar, Clear & Wright, 2017). In line with these strategies, creating a community and platform for connecting with other caretakers to facilitate learning, knowledge exchange, and cooperation could be a successful intervention area for design. Additionally, allowing integration with caretakers' social media accounts could motivate this user type by providing opportunities to socialize online and facilitate comparison and competition.

7.1.9 Providing Guidance to Support Reflection

Guidance is one of the key tenets of persuasive technologies to help people achieve a target behavior (Fogg, 2003). Although tracking dogs' physical activity through data is helpful in meeting their exercise needs, caretakers often require guidance during the reflection and action phases. For example, the Fitbark app provides limited guidance on how to take action for dogs' existing issues, such as low energy levels or lack of motivation for physical activity, weight issues, or missed activity goals. The app only provides generic suggestions that are often not contextualized and do not fit the varying individual circumstances of caretakers and dogs. Caretakers also need guidance on the average scores of dogs based on varying factors, such as breed and age, for each data type. Although this information is available on the Fitbark website, it is not on the app, and the lack of it acts as a barrier to meaningful reflection. Thus, improved guidance is needed to support reflection, and providing actionable feedback to support reflection can be another strategy. Even if guidance is offered, caretakers can still face difficulty following this type of guidance if it does not fit cultural and contextual differences, such as suggestions or notifications out of context.

Improved guidance related to the points mentioned above is needed for all user types. However, Indifferents, Compassionate Parents, and Physical Activity Supporters may need more guidance in terms of caregiving practices. Delivering more targeted information in an easily digestible way might be a more effective strategy to assist self-reflection for Indifferents, as they have difficulty fulfilling even the basic caregiving responsibilities. On the other hand, Compassionate Parents need to understand the affective states of their dogs to communicate with them and address their needs better. Thus, offering them better guidance about dog behavior through informative content can be more meaningful for them in terms of self-reflection.

Lastly, informing Physical Activity Supporters better about their dogs' activity needs based on age, breed, weight, and health condition can be useful to favor dog welfare, considering their constant effort to keep their dogs active. While it is a common misconception that more physical activity is always better for dogs, physical activity needs among dogs vary based on different factors such as breed characteristics, age, weight, health condition, behavioral problems, and individual differences (Coile, 2015; The Kennel Club, 2023).

7.1.10 Providing Improved Personalization for Meaningful Reflection

To improve guidance and support reflection and action stages, a strategy could be to provide personalized feedback to caretakers through the app. This feedback should be customized to address each caretaker's concerns and their dog's specific conditions and needs, such as weight, age, and psychological condition. For instance, if a dog has health issues or behavior problems that limit their physical activity or is old, the Fitbark app does not allow for this level of personalization when creating a dog profile, which can limit the usefulness of the feedback provided. Currently, the app only offers generic feedback based on the dog's age and breed. However, generic goals or suggestions may not be effective in motivating caretakers to monitor their dogs' physical activity levels. Hence, personalized suggestions based on the dog's individual differences, breed, age, physical and mental conditions, medical history, and character traits, as well as caretakers' persona types, are needed.

The information provided should be tailored to the caretaker's persona type and their dog's characteristics to ensure meaningful reflection and long-term adoption of DAMS. By providing personalized feedback, caretakers can better understand their dog's needs and make informed decisions about their physical activity levels, which can lead to improved overall health and well-being.

7.1.11 Enabling Self-Calibration through Improved Guidance

To improve the caretakers' motivation to monitor their dogs and set goals for their physical activity, there is a need for personalized goal-setting options based on the dog's individual differences, breed, age, physical and mental conditions, medical history, and changes in the daily schedule. The current types of goals available on the Fitbark app fall short of meeting the diverse needs of caretakers and dogs, as they do not allow for fine-tuning the activity goals based on individual circumstances. As a result, caretakers may lose their motivation or quit chasing the activity goals after a certain period.

It has been observed that some caretakers establish their own goals or evaluate their dogs' activity levels themselves if they are not motivated enough by the app's goals or fail to achieve them. However, in some cases, they may disregard the activity goals or stop using the feature altogether after a certain period of use. Thus, personalizing the goal-setting process based on the dogs' specific needs and caretakers' personas can enhance the effectiveness and sustainability of the DAMS. By offering flexibility and tailored goals, the app can motivate caretakers to monitor their dogs' physical activity levels and support their well-being in the long run.

7.1.12 Motivating to Support Action

Even if caretakers make sense and reflect on the data, it does not necessarily mean that they will take action, as they might also face barriers during the action phase, such as lack of time or motivation. Goal setting (Consolvo et al., 2009; Munson & Consolvo, 2012), reminders, and competition (Oinas-Kukkonen & Harjumaa, 2008) can motivate users in personal informatics systems to perform a target behavior.

All user types can benefit from goals, reminders, and social comparison as design strategies used in persuasive technologies, as suggested by Oinas-Kukkonen and Harjumaa (2008). However, these also should be tailored to each user type’s characteristics and needs. For example, Physical activity supporters can be motivated by competition and activity goals, while Indifferents can benefit from simple reminders to perform basic caregiving practices. Social learning and social comparison strategies can be used for Social Butterflies. On the other hand, Compassionate Parents can be motivated through notifications with a positive tone about their dogs' welfare state.

7.2 Discussion

In this thesis, the major findings are presented as caretaker personas and the DAMS-mediated stage-based awareness model. The DAMS-mediated stage-based awareness model is based on the stage-based model of Personal Informatics Systems by Li et al. (2010) and the Lived Informatics Model by Epstein et al. (2015), which are explained in Chapter 3. This model is similar to both models in terms of the stages that users go through, as DAMS is also a personal informatics system. The DAMS-mediated stage-based awareness model identifies the stages that dog caretakers go through when using dog activity monitoring systems, and it considers various types of users, or caretaker personas, who may use the system. These personas have unique concerns and behaviors related to dog care, and their experiences with the tracking system will differ accordingly.

However, the model also highlights a gap in previous research. While the stages that users go through when using personal informatics systems/human activity trackers are well understood, previous models do not explain how users interpret the tracking data they receive. This sensemaking stage is an essential part of the process, as it ultimately informs the actions that users take based on the tracking data they receive. Therefore, the DAMS-mediated stage-based awareness model aims to address this gap by incorporating a sensemaking stage into the process. Moreover, the model reveals users' experience, particularly with dog activity monitoring systems, which is an underexplored area in the field of HCI, to identify the dimensions of user experience with these systems and their implications on both caretakers' awareness and caregiving practices.

All the design strategies explained in this chapter are compiled on the design strategies matrix on Table 7.2 in relation to the related personas and the model stages.

Table 7.2. Design strategies matrix.

Design Strategies

Phase	Design strategy								
01 Sensemaking	Enhancing comprehensibility of information	● P1	● P2	● P3	● P4	● P5	● P6	● P7	● P8
01 Sensemaking	Providing data variety to support sensemaking	● P1	● P2	● P3	● P4	● P5	○ P1	○ P7	○ P8
01 Sensemaking	Ensuring compatibility with the existing mental models	● P1	● P2	● P3	● P4	● P5	● P6	● P7	● P8
01 Sensemaking	Providing a basis for meaningful comparison	● P1	● P2	● P3	● P4	● P5	● P6	● P7	○ P8
01 Sensemaking	Visualizing the tracking data to enhance understanding	● P1	● P2	● P3	● P4	● P5	● P6	● P7	● P8
01 Sensemaking	Showing data history to enable users to track their progress	● P1	● P2	● P3	● P4	○ P5	○ P6	○ P7	○ P1
01 Sensemaking	Supporting social sensemaking	○ P1	○ P2	● P3	○ P4	○ P5	● P6	○ P7	○ P8
02 Reflection	Enhancing contextualization to support meaningful reflection	● P1	● P2	● P3	● P4	○ P5	○ P6	○ P7	○ P8
02 Reflection	Providing guidance to support reflection	● P1	● P2	● P3	● P4	● P5	● P6	● P7	● P8
02 Reflection	Providing improved personalization for meaningful reflection	● P1	● P2	● P3	● P4	● P5	● P6	● P7	● P8
02 Reflection	Enabling self-calibration through improved guidance	● P1	● P2	● P3	● P4	● P5	○ P6	○ P7	○ P8
03 Action	Motivating to support action	● P1	● P2	● P3	● P4	● P5	● P6	● P7	● P8

P1 Info Geeks **P2** Attentive Health Guards **P3** Responsible Caretakers **P4** Physical Activity Supporters

P5 Compassionate Parents **P6** Social Butterflies **P7** Complainers **P8** Indifferents

CHAPTER 8

CONCLUSION

This thesis investigates caretakers' experience with dog activity monitoring systems, identifies user diversity, and explores the potential ways to increase dog caretakers' awareness via these systems to improve their quality of caregiving through a study examining the potential and possibilities of these technologies. With the aim of developing a theoretical model on how dog activity monitoring systems for companion dogs can mediate the human-dog relationship to improve humans' caregiving as a means to provide guidance to designers and researchers, the study asks the following main research question:

- How can we improve humans' awareness of dogs to enhance their quality of caregiving through the use of DAMS?

To respond to this main question, it asks the following sub-questions:

1. What are humans' different concerns and behaviors that characterize their caretaking fashion towards their dogs?
2. How do these concerns and behaviors vary among caretakers? What are the implications of this user diversity on the design of DAMS in terms of increasing human awareness?
3. How do dog caretakers make sense of and reflect on the data collected via DAMS?
4. What are the dimensions to increase humans' awareness through DAMS to improve their quality of caregiving (of their dogs)?
5. What are the design strategies to increase caretakers' awareness of their dogs via DAMS to support their caregiving?

The previous sections of this thesis have presented the findings and insights obtained through the research conducted in this doctoral study. The purpose of this chapter is to discuss the major conclusions and contributions of this research and to answer the research questions by reflecting on the literature to achieve the aim of this study. The next sections will first discuss how the research questions were answered through the study in the context of this thesis. After that, the contributions of the study to the existing knowledge will be discussed by situating it within the literature. Finally, the limitations of the study and potential directions for future research will be presented.

8.1 Revisiting the Research Questions

8.1.1 Q1: What are humans' different concerns and behaviors that characterize their caretaking fashion towards their dogs?

The way humans reflect on the data collected by DAMS has a direct impact on the welfare of companion dogs. Caretakers use monitoring data to reflect on various issues related to their dogs' welfare, such as their physical activity and feeding. However, humans' self-reflection processes regarding the data collected via DAMS can vary significantly based on their unique characteristics and personalities (Bentvelzen et al., 2021), as well as their lifestyle choices (Coşkun & Karahanoğlu, 2022). Thus, to better support caretakers' self-reflection processes and help them gain useful insights into their dogs' lives, it is important to provide monitoring data in a way that suits their level of willingness for self-reflection. To achieve this, designers and researchers should consider different user types while designing dog activity monitoring systems. Thus, caretaker variety regarding dog activity trackers should be considered while designing such systems to assist in humans' self-reflection processes and help them make more informed decisions about their companion animals' welfare.

To gain insights into the diverse behaviors and concerns of dog caretakers regarding dog care, I conducted in-depth interviews as part of a longitudinal study. These interviews aimed to collect qualitative data that would help me identify distinct concerns and behaviors among caretakers, which could potentially impact the use of tracking data collected through Dog Activity Monitoring Systems (DAMS). The gathered data allowed me to organize the identified concerns and behaviors into relevant groups, such as hygiene habits, time limitations, tracking practices, feeding habits, social life, information-seeking behaviors, monitoring habits, activity habits, healthcare practices, play habits, and daily schedules. These groups reflect different aspects of caregiving practices.

Through iterative coding of these diverse behaviors and concerns, certain patterns emerged, highlighting the diversity among caretakers participating in the study. For instance, there were *info geeks* characterized by their strong desire for knowledge about dog health and behavior. They actively sought out academic articles and pursued training in various topics related to dog care, including obtaining certifications in dog nutrition. On the other hand, *attentive health guards* exhibited more concerned behaviors related to their dogs' health, often due to existing health problems like being overweight or prone to weight gain. Consequently, they made efforts to help their dogs lose weight in order to prevent or alleviate potential health issues. As a result, they displayed a greater interest in learning about their dogs' calorie intake and activity requirements to effectively manage their weight.

These findings demonstrate the diverse range of behaviors and concerns among dog caretakers, along with their varying information needs, highlighting the need for personalized approaches to presenting data via DAMS. By understanding these unique perspectives, we can develop tailored interventions and technologies that address specific caretaker needs, ultimately improving the overall well-being of both dogs and their caretakers. Moreover, this information can guide designers and researchers in developing more effective dog activity monitoring systems and providing meaningful data for different user types. Chapter 5 provides detailed descriptions of these identified behaviors and concerns and their implications for designing dog activity monitoring systems. Overall, the study highlights the importance of understanding human behaviors and concerns related to dog care and how this information can help increase their awareness of their companion dogs via DAMS.

8.1.2 Q2: How do these concerns and behaviors vary among caretakers? What are the implications of this user diversity on the design of DAMS in terms of increasing human awareness?

Personas can provide designers with a clear understanding of who their users are, what their needs are, and what motivates them. This information can be used to guide design decisions and ensure that the end product is tailored to the specific needs of the user. Research has shown that people's user types are strong determinants of the perceived persuasiveness of different motivational strategies for behavior change (Orji et al., 2018). Therefore, using personas can be particularly useful for designing effective interventions that encourage behavior change. Understanding these personas and their information needs is essential for harnessing the persuasive potential of dog activity monitoring systems in designing interventions.

In this study, conducted within the scope of this thesis, I identified eight distinct caretaker personas, *attentive health guards, compassionate parents, complainers, responsible caretakers, info geeks, indifferents, social butterflies,* and *physical activity supporters*, through analysis of participants' descriptions of their behaviors and underlying reasons. These personas provide insight into various caretaking behaviors and concerns, as elaborated in Chapter 5.

The findings underscore the need for a holistic approach to designing interventions that enable dog caretakers to improve their caregiving quality through increased awareness. The study revealed distinct caretaker personas with unique characteristics and information needs. For instance, info geeks require access to comprehensive information about their dogs' welfare, while indifferents may benefit from targeted and easily digestible information. Attentive health guards require tailored information on balancing calorie intake and activity levels, and compassionate parents seek better guidance on understanding their dogs' affective states. Social butterflies can be motivated through social strategies such as creating communities and integrating with social media platforms. Physical activity supporters, on the other hand, would benefit from information tailored to their dogs' activity needs.

These insights highlight the importance of personalizing interventions to cater to the specific needs of each persona. These personas provide valuable insights into the varying information needs of different user types when designing DAMS and increasing human awareness of dog welfare.

The analysis also revealed significant relationships between persona characteristics and dogs' behavior traits, such as attachment, attention-seeking behavior, energy levels, and trainability. Indifferents’ dogs exhibited signs of attachment and attention-seeking behavior with high energy levels, but they displayed less concern for their dogs' welfare. This suggests the need to increase caretakers' awareness of their dogs' problems and unmet needs to foster better caregiving practices. By considering these varying needs, interventions can be more relevant, engaging, and effective in supporting caregiving quality and strengthening the bond between dogs and their caretakers. Overall, this study emphasizes the importance of designing personalized interventions that align with the characteristics and information needs of different caretaker personas. By doing so, it is possible to enhance human awareness, improve caregiving practices, and ultimately promote the well-being of dogs. The findings contribute to the field of dog-human relationships and offer valuable insights for the design of dog activity monitoring devices and interventions that facilitate behavior change and increased awareness among dog caretakers.

The findings of this study can assist design practitioners in representing diverse user needs during the design process, ensuring that DAMS are tailored to meet the requirements of different caretaker personas. Caretaker personas, as a major finding of the study, could serve as a valuable resource for the design of these systems. Moreover, the study highlights the importance of considering the diversity of user behaviors and concerns throughout the design process, as it affects multiple agents in the case of interactive systems for dogs. Therefore, the implications of this study are significant for designing DAMS that address the different requirements of caretakers while also increasing their awareness of their dogs' welfare.

8.1.3 Q3: How do dog caretakers make sense of and reflect on the data collected via DAMS?

The way people reflect on their self-tracking data can vary based on various aspects. Research has shown that individuals have different interpretations, understandings, and self-reflection processes based on their personalities and individual differences (Bentvelzen, Niess & Wozniak, 2021). Additionally, how people make sense of this data can be influenced by various inter-connected, data-related, and lifestyle factors (Coşkun & Karahanoğlu, 2022). The primary objective of collecting and making sense of data is to derive meaningful insights and reflect on the data to make positive changes in one's lifestyle or behavior. Therefore, it is crucial to understand how users make sense of information to support their self-reflection processes better and assist them in transforming personal data into useful insights for their lives.

Addressing a gap in HCI and ACI literature, this study investigates how caretakers make sense of their dogs' tracking data gathered through DAMS using a longitudinal study that includes the Fitbark device. The analysis of the second interview data revealed the phases caretakers go through while understanding, reflecting, and taking action based on their dogs' tracking data. Drawing on the stage-based model of Personal Informatics Systems by Li et al. (2010) and the Lived Informatics Model by Epstein et al. (2015), as explained in Chapter 3, this thesis introduces the stage-based DAMS-mediated awareness model to illustrate the process caretakers undergo in making sense of and reflecting on the data.

According to the model, the process begins with caretakers interacting with DAMS, followed by the data *Collection* phase, during which a significant amount of monitoring data related to dogs' physical activity is gathered, along with feedforward and feedback from the system. Caretakers monitor various types of information, such as physical activity and sleep quality, which they need to process mentally due to the overload of tracking information. Subsequently, the *Sensemaking* phase commences, where caretakers interpret the sensor data provided by DAMS.

Throughout these stages, various factors, including caretakers' persona types in terms of attitudes, habits, and intentions, as well as the characteristics of the dogs, may influence the process. Barriers encountered during the *Sensemaking* and *Reflection* stages may impede proper self-reflection and the transformation of tracking data into meaningful insights. In the *Reflection* stage, caretakers start to reflect on the tracking data and their caregiving behaviors and practices after interpreting and understanding this information at the *Sensemaking* stage. Similarly, the barriers faced at the *Reflection* stage can hinder caretakers from properly self-reflecting on their dogs' tracking data and turning this data into meaningful insights into their lives. Finally, in the *Action* stage, caretakers act upon the insights gained from the reflection phase, making positive changes in their lifestyles, caregiving practices, and behaviors.

The model serves as a valuable tool for researchers and designers, enabling them to consider the self-reflection process of caretakers and design systems that effectively support users in transforming dog monitoring data into meaningful insights for their lives and their dogs' lives.

8.1.4 Q4: What are the dimensions to increase humans' awareness through DAMS to improve their quality of caregiving (of their dogs)?

With the aim of determining how caretakers could be better supported in their use of dog tracking data to enhance their awareness of their dogs' health and behaviors, the study revealed the patterns in the way that caretakers reflect on their dogs' data provided via DAMS. Based on the findings, I identified the dimensions to increase caretakers' awareness of their dogs through the tracking data gathered via these systems. The dimensions were grouped into three categories according to the stage they are in the DAMS-mediated awareness process: making sense of tracking data, reflecting on tracking data, and behavior/action.

In the Sensemaking stage, various dimensions were found to influence how caretakers interpret dog activity monitoring data. These dimensions encompass *comprehending the information, contextualizing the data, sensemaking through comparison with other dogs, sensemaking through comparison with familiar patterns, social sensemaking,* and *sensemaking aided by data visualizations*. Caretakers also employ diverse strategies to make sense of the monitoring data, influenced by factors such as persona types, concerns and behaviors, mental models, past experiences, and the specific characteristics of their dogs.

Following the Sensemaking stage, caretakers attain awareness of issues related to their dogs and transition to the Reflection stage. Understanding the tracking data is essential for becoming aware of the issues that the data indicates. The Reflection stage starts when caretakers begin reflecting on their dogs' tracking data. Challenges encountered at this stage, including time constraints, lack of interest, or difficulties in retrieving, exploring, and comprehending the collected information, can hinder users from fully engaging with the data. The Reflection stage encompasses dimensions such *as checking for discrepancies, seeking guidance for reflection, selective attribution/focus, data handling, tracking trends in the data,* and *self-calibration*.

After progressing from the Sensemaking and Reflection stages, users enter the Action stage, where they determine how to act based on their newfound understanding of their dogs' tracking information. In this stage, users may adjust their behavior to align with their goals. Dimensions within this category include the *effects on lifestyle* and *changes in the caregiving approach/behavior* associated with DAMS usage.

These dimensions provide valuable insights for researchers and design practitioners, enabling a deeper understanding of how caretakers interact with DAMS while reflecting on dog tracking data and identifying potential intervention areas to enhance caretakers' awareness of their dogs through these systems. Chapter 6 presents further details on the identified dimensions, offering guidance to researchers and designers in developing improved tracking systems for dogs. By leveraging these dimensions, researchers and designers can create tracking systems that empower caretakers to translate data into meaningful insights for their lives, ultimately improving their caregiving practices and supporting the welfare of their dogs.

8.1.5 Q5: What are the design strategies to increase caretakers' awareness of their dogs via DAMS to support their caregiving?

Based on the dimensions to increase caretakers' awareness via DAMS, along with the barriers to the individual stages of the DAMS-mediated awareness model, which have been identified through the study, design strategies are developed to guide researchers and design practitioners during the design and development of DAMS. These design strategies were formulated in consideration of different caretaker persona characteristics, their information needs, the specific stages they go through while interpreting and reflecting on the tracking data, the identified dimensions to increase caretakers' awareness via DAMS, and the barriers that affect individual stages of the DAMS-mediated awareness model. For the sensemaking stage, the following strategies have been formulated: enhancing the comprehensibility of information, providing diverse types of data to support sensemaking, facilitating contextualization to foster meaningful reflection, establishing a basis for meaningful comparison, ensuring compatibility with mental models, visualizing the tracking data to enhance understanding, displaying data history to enable progress tracking, and supporting social sensemaking. Regarding the reflection stage, the proposed strategies include providing guidance to support reflection, offering actionable feedback to facilitate reflection, enhancing personalization for meaningful reflection, and enabling self-calibration through improved guidance and user engagement. Finally, the suggested strategy for the action stage is to provide motivation to support action.

These strategies can contribute to the design and development of DAMS that are highly effective in addressing the barriers caretakers encounter when interpreting, reflecting upon, and taking action based on their dogs' tracking data. By incorporating these design strategies, designers and researchers can create DAMS that specifically cater to caretakers' needs and requirements during their interaction with these systems. As a result, these strategies serve as a valuable guide in developing DAMS that successfully address the challenges faced by caretakers. Ultimately, the adoption of these strategies can lead to the design of enhanced tracking systems for dogs. By enabling caretakers to better comprehend and reflect upon their dog's activity tracking data, these systems can facilitate positive changes in the lifestyle and behavior of their pets. Through improved awareness and informed decision-making, caretakers can make meaningful adjustments to their dog's routines, which is likely to lead to improved welfare and overall quality of life for their beloved companions.

8.1.6 MQ: How can we improve humans' awareness of dogs to enhance their quality of caregiving through the use of DAMS?

In conclusion, by addressing all of the sub-questions mentioned above, this study has revealed the ways to increase humans' awareness of companion dogs and enhance the quality of their caregiving, answering the main research question. The identified strategies can be applied during the design and development of DAMS, by taking into account the varying needs of caretaker personas and the process they go through when interacting with dog tracking data. This can help to attain the full potential of these technologies to enhance human awareness of dogs' welfare and support their caregiving. Therefore, all the dimensions identified in this study, including the self-reflection process, user diversity, and design strategies with respect to their corresponding model stages, should be considered in combination.

8.2 Contributions of the Thesis

By addressing the research questions, this doctoral study has provided valuable contributions to knowledge that can benefit both design research and design practice in multiple ways.

8.2.1 Caretaker Personas

One of the primary contributions of this thesis to the knowledge base in design research and practice is the identification of caretaker personas through the research study. Exploring user diversity is especially crucial for newly developing animal technologies because of their potential implications on animal welfare. Thus, designers, design researchers, and other stakeholders interested in the research and design of animal technologies can refer to the results of this study, which provide guidance for the design of dog activity monitoring systems in terms of user diversity. Additionally, it can help designers and researchers empathize with the users of these systems, understand their varying needs and preferences while interacting with the tracking data, and recognize diverse approaches for enhancing human awareness and the quality of caregiving for dogs. Although the identified caretaker personas and their characteristics specifically relate to the use of dog activity monitoring systems, the same methodological approach can be applied to the exploration of other animal technologies, such as interactive systems for non-human animals. This can support the development of design interventions that promote positive behavior change for humans, increase their awareness, and ultimately enhance their caregiving quality for companion animals, with the aim of promoting animal welfare through design.

8.2.2 DAMS-Mediated Stage-Based Awareness Model

The DAMS-mediated stage-based awareness model is based on the stage-based model of Personal Informatics Systems by Li et al. (2010) and the Lived Informatics

Model by Epstein et al. (2015), which are explained in Chapter 3. This model is similar to both models in terms of the stages that users go through, as DAMS is also a personal informatics system. The DAMS-mediated stage-based awareness model identifies the stages that dog caretakers go through when using dog activity monitoring systems, and it considers various types of users, or caretaker personas, who may use the system. These personas have unique concerns and behaviors related to dog care, and their experiences with the tracking system will differ accordingly.

However, the model also highlights a gap in previous research. While the stages that users experience when using personal informatics systems for humans are well understood, previous models do not explain how users interpret the tracking data they receive. This sensemaking stage is an essential part of the process, as it ultimately informs the actions that users take based on the tracking data they receive. Moreover, the model reveals users' experience, particularly with dog activity monitoring systems, which is an underexplored area in the field of HCI and ACI, to identify the dimensions of users' experience with these systems and their implications on both caretakers' awareness and caregiving practices. Therefore, the DAMS-mediated stage-based awareness model aims to address this gap by incorporating a sensemaking stage into the process and modeling caretakers' experience when reflecting on their dogs' tracking data.

8.3 Limitations of the Study and Future Directions

The use of dog activity monitoring devices, similar to other animal technology, is a topic involving multiple stakeholders, such as dogs, humans, and technology. As mentioned in Chapter 2, over the past decade, the design space has shifted its focus from anthropocentric perspectives that put humans at the center and expanded to include more-than-human design (MTHD) approaches and methodologies (Coşkun et al., 2022). For instance, in Actor-Network Theory (ANT), a theoretical and methodological approach that considers human and non-human actors as equal stakeholders in an ever-changing network of relationships (Latour, 2007), humans are no longer considered as a single agent in a system and the existence of many other non-human actors is acknowledged. In line with this contemporary approach to design, it is crucial to integrate the perspective of dogs as non-human actors in the design of dog activity monitoring systems. This study, within the context of this thesis, is limited to the human perspective in exploring the potential of activity tracking systems for dogs, although I have identified caretaker personas and how they may have an impact on the dog-human relationship and dog welfare. However, future studies should also investigate dog personas to represent dog users and their needs and preferences during the design and development of such technologies, along with their human companions.

In addition, the device used in the study posed limitations in terms of its features. It had limited capabilities in terms of the technology it used, providing only 3D accelerometer data that measured the activity and inactivity of dogs. Other data types available in the system were essentially calculated based on this data. Although more advanced types of dog activity monitoring devices were available on the market, such as those for monitoring certain types of behaviors in addition to activity, they could not be used in the study due to their unavailability in the country where the study was conducted. Investigating caretakers' experience with various data types could provide more opportunities to explore the potential and possibilities of these systems regarding human behavior change. This was another limitation of the study. Therefore, future work should also explore these more advanced technologies regarding their implications for human awareness and behavior.

Furthermore, future studies should be conducted to evaluate the effectiveness of the proposed design strategies for DAMS. These studies should aim to assess the impact of these strategies on the overall well-being of both caretakers and their companion dogs. By conducting evaluations and gathering empirical evidence, researchers can gain insights into how the suggested design strategies contribute to enhancing dog welfare and caregiving quality of caretakers. This evaluation should encompass various aspects, including caretakers' satisfaction, engagement with the system, behavior changes, and their effects on caregiving quality. Additionally, objective measurements such as physical activity levels, stress indicators, and behavioral patterns of the companion dogs can provide valuable insights into the impact of these strategies on dog welfare derived from the implementation of these design strategies. Through robust and comprehensive evaluations, future studies will shed light on the potential of the proposed design strategies for DAMS to positively influence the well-being of caretakers and their companion dogs.

Lastly, the study had limitations in terms of participant diversity. Although the participants were recruited to provide variety regarding dog and caretaker demographics, the study sample was limited in terms of certain aspects, such as dog breed, the existence of children, and income, which could affect the results. Studies show that these demographic variables, such as dog age, size, breed, and length of dog ownership, as well as other demographic variables, such as the presence of children, marital status, age, education, and income, have correlations with various dog companionship dimensions. Therefore, the findings of the study cannot be generalized to a larger population. Thus, for future studies, a more varied sample of caretakers should be studied to explore user diversity further.

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APPENDICES

A. Consent Form

Katılıcı Bilgilendirme ve İzin Formu	
Araştırma konusu: Köpekler için giyilebilir aktivite takip cihazları ve bu cihazlara ait mobil uygulamaların hayvan ve hayvan sahipleri arasındaki bağı nasıl etkilediğinin incelenmesi **Araştırmacı:** Aslıhan Tokat, Doktora öğrencisi, Orta Doğu Teknik Üniversitesi Bu araştırma Orta Doğu Teknik Üniversitesi Endüstriyel Tasarım Bölümünde yürütülen bir doktora tezi kapsamında yapılmaktadır. Araştırmada köpekler için giyilebilir aktivite takip cihazları ve bu cihazlara ait mobil uygulamaların hayvan ve hayvan sahipleri arasındaki bağı nasıl etkilediği incelenecektir. Altı hafta sürecek bu araştırma öncesinde katılımcılara, köpekler için giyilebilir bir aktivite takip cihazı olan Fitbark verilerek köpeklerinin tasmasına takmaları ve ürüne eşlik eden mobil uygulamayı süreç boyunca kullanmaları istenecektir. Araştırma, cihaz kullanım öncesi, kullanımı ve kullanım sonrası olmak üzere üç aşamadan oluşmaktadır. Kullanım öncesi aşamasında ilk olarak köpek sahiplerinin köpekleriyle olan ilişkilerini anlayabilmek ve bu ilişkiyi gerçek ortamında gözlemleyebilmek için katılımcıların, evlerinden video konferans yoluyla bağlanması sağlanarak öncül bir görüşme gerçekleştirilecektir. Ardından, köpekler ve köpek sahipleri arasındaki bağ, anket yoluyla değerlendirilecek ve katılımcıların köpeklerine dair bilmek istedikleri bilgiler, bir aktivite yoluyla sorgulanacaktır. Bu aşamadan sonra, katılımcılardan ürünleri altı hafta boyunca kullanmaları istenecektir. Katılımcıların günlük rutinlerini etkilemeyecek şekilde, altı hafta boyunca her hafta, bir kez hafta içi bir kez de hafta sonu olmak üzere, internet üzerinden bir form ile deneyimlerine dair sorular sorulacaktır. Araştırma süreci boyunca, iki haftalık aralıklarla telefon görüşmeleri yapılacak ve bu görüşmelerde katılımcılara kullanımın gidişatı ve süreç içinde araştırmacıya aktardıkları bilgilerle ilgili sorular sorulacaktır. Araştırma, süreç sonunda video konferans yoluyla yapılacak bir görüşme ile tamamlanacaktır. Çalışma sırasında katılımcılardan elde edilen veriler yalnızca aşağıda ismi geçen araştırmacılar tarafından incelenecek ve analiz edilen veriler bilimsel amaçlarla, tez çalışmasında, bilimsel yayınlarda ve sunuşlarda kullanılacaktır. Araştırma çıktılarında, katılımcıların kimlik bilgilerinin gizli tutulması için gerekli bütün önlemler alınacaktır. Araştırma sonuçları yayınlarda ve raporlarda anonimleştirilerek sunulacak, kimlik bilgilerini ortaya koyacak hiçbir veri paylaşılmayacaktır. Bu formu imzalayarak yapılacak araştırma konusunda size verilen bilgiyi anladığınızı ve görüşmenin yapılmasını onaylamış oluyorsunuz. Bu formu imzalamış olmanız yasal haklarınızdan vazgeçtiğiniz anlamına gelmemektedir. Görüşme sürecinin başlangıcında veya herhangi bir aşamasında açıklama yapılmasını veya bilgi verilmesini isteyebilirsiniz. İstediğiniz zaman gerekçe belirtmeksizin görüşmeyi veya çalışmayı sonlandırmayı talep edebilirsiniz. Araştırmaya katkıda bulunduğunuz için teşekkür ederiz.	
Araştırmacı: Aslıhan Tokat ODTÜ Endüstriyel Tasarım Bölümü, Doktora Öğrencisi aslihantokat@gmail.com	**Tez Danışmanı Öğretim Üyesi:** Dr. Öğr. Üyesi Gülşen Töre Yargın ODTÜ Endüstriyel Tasarım Bölümü, Öğretim Üyesi tore@metu.edu.tr
Katılımcının Adı Soyadı:	**İmzası:** **Tarih:**

B. Participant Information Survey Questions

Katılımcı İletişim Bilgileri

1. Adınız Soyadınız?
2. Telefon Numaranız?
3. E-Posta adresiniz?
4. Yaşınız?
5. En son elde edilen akademik dereceniz?
   ☐Lise ☐Lisans ☐Yüksek Lisans ☐Doktora ☐Diğer (Lütfen belirtiniz):
6. Mesleğiniz?
7. Köpeğiniz ile birlikte kimlerle yaşıyorsunuz?
   ☐Yalnız yaşıyorum ☐Eş/Partner ile ☐Ebeveyn/ebeveynler ile ☐Diğer (Lütfen belirtiniz)

Köpeğinizle İlgili Bilgiler

8. Köpeğinizin ismi?
9. Köpeğinizin yaşı?
10. Köpeğinizin cinsiyeti?
11. Köpeğinizin ırkı?
12. Köpeğinizin yaklaşık kilosu?
13. Köpeğinizi nereden sahiplendiniz?
14. Köpeğinizi sahiplenirken temel motivasyonunuz neydi?
    ☐Bana arkadaşlık etmesi ☐Beni/ailemi/evimi koruması ☐Köpeğimin bir eve ihtiyacı vardı ☐Diğer evcil hayvanlarıma arkadaşlık etmesi ☐Köpek sporlarında/yarışlarında yarıştırmak ☐Birlikte egzersiz yapmak ☐Diğer (Lütfen belirtiniz)
15. Köpeğinizi ne kadar süre önce sahiplendiniz?
16. Köpeğiniz sahiplendiğinizde kaç yaşındaydı/aylıktı/haftalıktı?
17. Köpeğinizin beslenmesinden temel olarak siz mi sorumlusunuz?
    ☐Evet ☐Hayır ☐Ailede eşit olarak üstleniyoruz
18. Köpeğinize egzersiz (yürüme, koşma vb.) yaptırmaktan temel olarak siz mi sorumlusunuz?
    ☐Evet ☐Hayır ☐Ailede eşit olarak üstleniyoruz
19. Köpeğiniz herhangi bir profesyonel aktivitede bulunuyor mu?
    ☐Irk yetiştiriciliği/şov köpeği ☐Avlanma ☐Diğer sporlar (Agility vb.) ☐İş köpeği (Arama kurtarma vb.) ☐Yukarıdakilerin hiçbiri ☐Diğer (Lütfen belirtiniz)
20. Köpeğinizi kısırlaştırdınız mı?
21. Evet ise, kısırlaştırdığınızda kaç yaşındaydı?
22. Kısırlaştırmada öncelikli neden neydi?
23. Köpeğinizde herhangi bir sağlık problemi mevcut mu?

24. Evet ise, köpeğinizin sağlık problemini kısaca açıklayabilir misiniz?
25. Köpeğinizin yıllık aşılarını yaptırıyor musunuz?
26. Köpeğinizi ne sıklıkla veterinere götürüyorsunuz?
    ☐Ayda birkaç kez ☐Ayda bir ☐3 ayda bir ☐Yılda 1 ☐Hiç götürmüyorum ☐Diğer
27. Köpeğiniz oyun oynuyor mu?
28. Nerede oyun oynuyor?
    ☐Evde ☐Bahçede ☐Köpek parkında ☐Diğer
29. Hangi sıklıkta oyun oynuyor?
    ☐Günde 1'den fazla ☐Günde 1 ☐Haftada 1 ☐Ayda 1 ☐Diğer
30. Kiminle/kimlerle oyun oynuyor?
    ☐Kendi başına ☐Benimle ☐Diğer köpek/lerle ☐Diğer evcil hayvanlarla ☐Diğer
31. Nasıl oyunlar oynuyor?
    ☐İnteraktif oyunlar ☐Top atma-geri getirme ☐Saklambaç ☐Diğer
32. Köpeğinize ne sıklıkla egzersiz yaptırıyorsunuz?
    ☐Günde 1 kez ☐Günde 2 kez ☐Günde 2 kereden fazla ☐2 günde bir hiç yaptırmıyorum ☐Diğer
33. Köpeğiniz en çok hangi tür egzersiz yapıyor?
    ☐Yürüyüş ☐Tasmasız koşma ☐Bisiklet egzersizi ☐Diğer
34. Köpeğinizle gün içinde egzersiz ve oyun sırasında ne kadar vakit geçiriyorsunuz?
    ☐1 saatten az ☐1-3 saat ☐3-5 saat ☐Diğer
35. Köpeğinizle gün içinde egzersiz ve oyun dışında ne kadar vakit geçiriyorsunuz?
    ☐1 saatten az ☐1-3 saat ☐3-5 saat ☐Diğer
36. Köpeğinizi günde ne sıklıkla besliyorsunuz?
    ☐Günde 1 ☐Günde 2 ☐Günde 3 kez veya daha fazla ☐Diğer
37. Köpeğinize ne tür besinler veriyorsunuz?
    ☐Konserve/Yaş mama ☐Kuru mama ☐Ev yemeği ☐Et ve kemik ☐Diğer
38. Bu sizin ilk köpeğiniz mi?
39. Hayırsa daha önce kaç köpeğe sahip oldunuz?
    ☐1-2 ☐3-5 ☐6-10 ☐10'dan fazla
40. Çocukken köpeğiniz var mıydı?
41. Evinizde başka köpek var mı?
42. Evetse, bu köpekler Fitbark cihazını takacağınız köpeğinizden...
    ☐Daha yaşlı ☐Daha genç ☐Aynı yaşta ☐Hem daha yaşlı hem daha genç ☐Hem daha yaşlı hem de aynı yaşta ☐Hem daha genç hem de aynı yaşta

Köpeğinizle İlgili Bilgiler

43. Köpeğinizde takip eden sorularda belirtilen davranışları ne sıklıkla gözlemliyorsunuz?

(Asla) 0 – 1 – 2 – 3 – 4 (Her zaman)

44. Patisini kaldırma
45. Ağzında yemek olmadığı halde ağzını şapırdatma/çiğneme
46. Islak olmadığı halde silkelenme
47. Onun olmayan eşyaları çiğneme
48. Kendisini aşırı derecede yalama/dişleme
49. Kendisini aşırı derecede kaşıma
50. Saklanma

C. ESM Survey Questions

1. Adınız Soyadınız?
2. Bu hafta uygulamayı ne sıklıkta kullandınız?
   ☐Günde 3 kereden fazla
   ☐Günde 1 veya 2 defa
   ☐Birkaç gün aralıkla bir defa
   ☐Hiç kullanmadım
3. Uygulamanın hangi özelliklerini kullandınız?
   ☐Activity (Barkpoints)
   ☐Sleep quality (Uyku kalitesi)
   ☐Play time (Oyun süresi)
   ☐Active time (Aktif zaman)
   ☐Rest (Dinlenme)
   ☐Distance (Mesafe)
   ☐Goals (Hedef belirleme)
   ☐Health (Sağlık)
   ☐Calories (Kalori)
   ☐Weight (Ağırlık)
   ☐Top dog board (En iyi köpek sıralaması)
   ☐Discover friends (Arkadaşları keşfet)
   ☐Haftalık Rapor
   ☐Shuffle Suggestions
   ☐Diğer
4. Uygulamadan aldığınız bilgilere göre verdiğiniz kararlar oldu mu? Olduysa örnek verebilir misiniz?
5. Bu süreçte uygulamanın/ürünün en çok hangi özelliği veya özellikleri işinize yaradı?
   ☐Activity (BarkPoints)
   ☐Sleep quality (Uyku kalitesi)
   ☐Play time (Oyun süresi)
   ☐Active time (Aktif zaman)
   ☐Rest (Dinlenme)
   ☐Distance (Mesafe)
   ☐Goals (Hedef belirleme)
   ☐Health (Sağlık)
   ☐Calories (Kalori)
   ☐Weight (Ağırlık)
   ☐Top dog board (En iyi köpek sıralaması)

☐Discover friends (Arkadaşları keşfet)
☐Haftalık Rapor
☐Shuffle Suggestions
☐Diğer

6. Eklemek istediğiniz başka bir şey var mı?

D. Study Procedure

[Katılımcılara kullanım aşamasından önce cihaz ve basılı araştırma kartlarını (ve sürpriz hediyeleri) içeren bir araştırma kiti teslim edilecektir.]

Araştırma Aşamaları

Kullanım Öncesi Aşaması

[Katılımcılarla iletişime geçildikten sonra, ilk görüşme öncesinde katılımcı onay formu ve katılımcı bilgileri formu iletilecektir. Katılımcı bilgileri formundan alınan cevaplar ilk görüşme öncesi incelenecektir.]

1. **Katılımcı Bilgileri Formu**: Köpeğe ilişkin bilgiler bölümü ve köpek sahipleri için köpeklerinde gözlemledikleri genel vücut diliyle/stres davranışlarıyla ilişkili çizim destekli soruları da içermektedir.
2. **Görüşme 1:** Katılımcılara bu aşamada köpekleriyle olan ilişkilerinin anlaşılmasına yönelik sorular sorulacaktır. Bu aşamanın, COVID-19 salgını öncesi, insan-köpek bağının doğal ortamında gözlemlenebilmesi için katılımcıların evlerinde gerçekleştirilmesi hedeflenirken, salgın sonrası değişen koşullar göz önünde bulundurularak video konferans yoluyla gerçekleştirilmesi planlanmaktadır.

1.Görüşme Soruları
Amaç: Katılımcıların köpekleriyle olan ilişkilerinin sorgulanması.
S1: Köpeğinizi sahiplenirken motivasyonunuz neydi/neden sahiplendiniz?
S2: *(Aile üyeleriyle, eşi/partneriyle yaşıyorsa)* Köpeğinizi siz mi sahiplendiniz yoksa aileniz/eşiniz/partneriniz mi?
S3: Köpeğin bakımıyla kim ilgileniyor? Besleme, egzersiz, oyun ve temaslı iletişim (okşama-masaj-tarama) için ayrı ayrı cevap verebilirsiniz.
S4: Köpeğinizi sahiplendikten sonra günlük yaşamınız nasıl değişti?
S5: Köpeğinizle geçirdiğinizi bir gününüzü anlatır mısınız? Bu rutin hafta içi/hafta sonu değişiyor mu? Nasıl?
S6: Şimdiye kadar köpeğinizin sağlık/aktivite/beslenme takibine yönelik herhangi bir mobil uygulama kullandınız mı? • Eğer kullandıysanız hangi tür uygulama(lar)? Neden bu uygulamayı tercih ettiniz? Hangi özelliklerini kullandınız? Hangi özelliklerini faydalı buldunuz? Neden? Hangi özelliklerini faydasız buldunuz? Neden? • Kullanmadıysanız kullanmayı düşünür müsünüz? Neden?

S7: Köpeğinizin herhangi bir sağlık sorunu var mı/daha önce yaşadınız mı? Varsa ne(ler)? Bunlar günlük yaşamınızda ne tür değişikliklere neden oldu?
S8: Köpek bakımında zorlandığınızı düşündüğünüz konular var mı? Varsa açıklar mısınız? Yardım alabilme şansınız olsaydı hangi konularda yardım almak isterdiniz?
[Katılımcılara basılı olarak verilecek keşke kartında yer alan sorular bu aşamada da sorulacaktır. Ayrıca sonradan aklına gelenleri kart üzerine de yazabileceği belirtilecektir.]
S9: Köpeğinizle ilgili en çok neyi merak ediyorsunuz/neyi öğrenmek isterdiniz? Neden?
S10: Köpeğiniz konuşabilseydi ona ne sormak isterdiniz? (Duyguları, düşünceleri, ihtiyaçları, istekleri vb.) Neden?

3. C-BARQ Davranış Değerlendirme Anketi
4. MDORS Anketi

[Bu aşamanın sonunda katılımcılara 6 hafta boyunca her gün kullanmaları istenecek olan ürün (Fitbark) ve ürüne ait mobil uygulama tanıtılacak ve araştırmanın bir sonraki aşamasıyla ilgili bilgi verilecektir].

Kullanım Aşaması

1. **ESM Formu:** Bu aşamada katılımcıların ürünle ilgili uzun dönem deneyimlerinin ve ürünün köpekleriyle aralarındaki bağı nasıl etkilediğinin anlaşılması amacıyla aşağıdaki sorular altı hafta boyunca, hafta içi bir gün ve hafta sonu bir gün olmak üzere (Cuma ve Pazar günleri) her hafta iki kez Google Forms üzerinden sorularak cevaplamaları istenecektir. Katılımcılara bu günlerde SMS, WhatsApp, e-posta vb. seçilen bir ortam üzerinden, formu doldurmaları ve uygulamayı kullanmalarını hatırlatmak amaçlı kısa mesajlar gönderilecektir.

2. **Keşke Kartları *(Araştırma kiti içinde basılı olarak gönderilecek)*:** Bu aşamada katılımcılara, köpekleriyle ilgili öğrenmek istedikleri/merak ettikleri bilgilerin sorgulanmasına yönelik üzerinde aşağıdaki soruların bulunduğu kartlar sunulacak ve katılımcıların kartları doldurmaları istenecektir.
   - Köpeğinizle ilgili en çok neyi merak ediyorsunuz/neyi öğrenmek isterdiniz? Neden?
   - Köpeğiniz konuşabilseydi ona ne sormak isterdiniz? (Duyguları, düşünceleri, ihtiyaçları, istekleri vb.) Neden?

3. **Video Ödevi** *(Opsiyonel)* (Ödev kartı araştırma kiti içinde basılı olarak gönderilecek):

   Köpeğinizin mutlu/mutsuz/kızgın/korkmuş... olduğunu düşündüğünüz bir anın kısa videosunu çekip, belirtilen e-posta adresi veya X no.lu telefona WhatsApp aracılığıyla gönderiniz. #mutlukopek #mutsuzkopek…

Kullanım Sonrası Aşaması

1. **Görüşme 2:** Bu aşamada katılımcılara, ürünle ilgili uzun dönem deneyimlerinin ve ürünün köpekleriyle olan bağı nasıl etkilediğinin anlaşılması için video konferans yoluyla aşağıdaki sorular sorulacaktır.

Görüşme 2
*Sorular yöneltilirken katılımcıların 6 haftalık kullanım deneyimlerini hatırlamaları istenecektir.
S1: Ürün ve uygulamayla ilgili genel izleniminiz nedir?
S2: Cihazın/uygulamanın kullanımıyla ilgili her şey yolunda gitti mi? Herhangi bir sorun yaşadınız mı?
S3: Altı hafta boyunca tüm uygulama kullanım deneyimlerinizi düşünürseniz ürün ve uygulama kullanımının köpeğinizle olan ilişkiniz üzerinde etkisi hakkında ne düşünüyorsunuz? İlişkiniz nasıl etkilendi? Neden?
S4: Cihazı/uygulamayı en sık hangi zamanlarda kullandınız? Neden?
S5: Köpeğinize ne sıklıkla egzersiz yaptırıyorsunuz? (Egzersizin türü?) • Günde 1 • Günde 2 • Günde 2 kereden fazla • 2 günde bir • Hiç çıkarmıyorum • Diğer Sizce ürünün kullanımı bu durumu etkiledi mi? Nasıl?
S6: Köpeğiniz oyun oynuyor mu? • Oynuyorsa, nerede? (evde, bahçede, köpek parkında vb.) • Hangi sıklıkta? (günde 1, günde 1'den fazla, haftada 1, ayda 1 vb) • Kimlerle? (kendi başına, sahibiyle, diğer köpek, diğer pet hayvanı vb) Nasıl oyunlar? (interaktif, top atma-getirme, saklambaç vb). Sizce ürünün kullanımı bu durumu etkiledi mi? Nasıl?
S7: Köpeğinizi ne sıklıkla veterinere götürüyorsunuz? • Ayda birkaç kez • Ayda 1 • 3 ayda bir • Yılda 1 • Hiç götürmüyorum • Diğer Sizce ürünün kullanımı bu durumu etkiledi mi? Nasıl?
S8: Köpeğinizi ne sıklıkla besliyorsunuz? • Günde 1 kere • Günde 2 kere • Günde 2 kereden fazla

• Diğer Sizce ürünün kullanımı bu durumu etkiledi mi? Nasıl?
S9: Köpeğinize ne tür besinler veriyorsunuz? • Konserve/yaş mama • Kuru mama • Ev yemeği • Et ve kemik • Diğer
S10: Köpeğinizle gün içinde ne kadar vakit geçiriyorsunuz? (çoktan seçmeli) *(Egzersiz ile oyunda geçirilen vakit ve egzersiz ile oyun harici geçirilen vakit olarak ayrı ayrı sorulacak)* • 1 saatten az • 1-3 saat • 3-5 saat • Diğer Sizce ürünün kullanımı bu durumu etkiledi mi? Nasıl?
[Bu aşamada görüşme öncesinde incelenmiş olan ESM formlarındaki çarpıcı bilgilere ilişkin sorular sorulur]
S11: Geçtiğimiz 6 haftada doldurduğunuz formlarda ürünün en çok X özelliğini kullandığınızı belirtmişsiniz? Nedenini açıklar mısınız?
S12: Sizce ürün ve uygulamanın iyi/sevdiğiniz özellikleri nelerdir? Ne açılardan?
S13: Sizce ürün ve uygulamanın kötü/sevmediğiniz özellikleri nelerdir? Ne açılardan?
S14: Ürün ve uygulama sizi nasıl daha mutlu ederdi? Bu ürün ve uygulamanın geliştirilmesi için önerileriniz var mı? Başka hangi özellikleri olsa köpeğinizle olan ilişkinizi olumlu yönde etkilerdi?
S15: Bundan sonra da ürünü ve uygulamayı kullanmayı düşünür müydünüz? Neden?
[Bu aşamada katılımcılardan keşke kartlarına yazılanlar ve video ödevi sonuçlarından kısaca bahsetmeleri istenecek.]

2. MDORS Anketi

[Bu anketi doldururken tasmayı kullandığınız dönemi ve güncel durumu göz önünde bulundurarak cevap vermenizi rica ediyorum. Eğer bir değişiklik olduğunu düşünüyorsanız bana açıklarsanız sevinirim].

E. Measurement Tools (Turkish Versions)

MDORS

Alt Ölçek 1: Köpek-Sahip Etkileşimi (Puan skalası: 9-45)	Asla	Ayda bir kez	Haftada bir kez	Birkaç günde bir	Günde en az bir kere
Köpeğinizi ne sıklıkla öpersiniz?	1	2	3	4	5
Köpeğinizle ne sıklıkla oyun oynarsınız?	1	2	3	4	5
	Asla	Yılda bir kez	Ayda bir kez	Haftada bir kez	Günde bir kez
Köpeğinizi ne sıklıkla diğer insanları ziyarete götürürsünüz?	1	2	3	4	5
	Asla	Yılda iki kez	Ayda bir kez	İki hafta bir	Haftada bir kez
Köpeğinize ne sıklıkla hediye alırsınız?	1	2	3	4	5
	Asla	Ayda bir kez	Haftada bir kez	Birkaç günde bir	Günde en az bir kere
Köpeğinize ne sıklıkla ödül maması verirsiniz?	1	2	3	4	5
Köpeğinizle ne sıklıkla arabaya binersiniz?	1	2	3	4	5
Köpeğinizi ne sıklıkla tararsınız?	1	2	3	4	5

	Asla	Yılda iki kez	Ayda bir kez	Haftada bir kez	Günde en az bir kere
Ne sıklıkla dinlenirken köpeğinizi yanınızda bulundurursunuz (örn. televizyon izleme)?	1	2	3	4	5

Alt Ölçek 2: Duygusal Yakınlık (Puan skalası: 10-50)	Kesinlikle katılmıyorum	Katılmıyorum	Ne katılıyorum ne katılmıyorum	Katılıyorum	Kesinlikle katılıyorum
Köpeğim zor zamanları atlatmama yardımcı olur.	1	2	3	4	5
Ne zaman avunmaya/rahatlamaya ihtiyacım olsa köpeğim oradadır.	1	2	3	4	5
Herkes beni terk etse, köpeğim hala benim için burada olurdu.	1	2	3	4	5
Köpeğimi her zaman yanımda isterim.	1	2	3	4	5
Köpeğim bana her zaman arkadaşlık/yoldaşlık eder.	1	2	3	4	5
Köpeğim bana karşı her zaman dikkatli/özenlidir.	1	2	3	4	5
Köpeğim, sabah kalkmam için bana bir neden veriyor.	1	2	3	4	5
Köpeğim ve ben keşke hiçbir zaman ayrılmasak.	1	2	3	4	5

	Asla	Ayda bir kez	Haftada bir kez	Birkaç günde bir	Günde en az bir kere
Ne sıklıkla başkasına anlatmadığınız şeyleri köpeğinize anlatırsınız?	1	2	3	4	5

	Hiç travmatik değil	Travmatik değil	Nötr	Travmatik	Çok travmatik
Köpeğinizin ölmesinin sizin için ne kadar travmatik olacağını düşünüyorsunuz?	1	2	3	4	5

Alt Ölçek 3: Algılanan Zararlar (Puan skalası: 9-45)	Asla	Yılda bir kez	Ayda bir kez	Haftada bir kez	Günde bir kez
Ne sıklıkla köpeğinize bakmanın zevksiz bir iş/angarya olduğunu düşünürsünüz?	1	2	3	4	5
Köpeğiniz ne sıklıkla yapmak istediğiniz şeyleri yapmanıza engel oluyor?	1	2	3	4	5
Ne sıklıkla köpek sahibi olmanın zahmete değmediğini düşünüyorsunuz?	1	2	3	4	5
	Kesinlikle katılmıyorum	Katılmıyorum	Ne katılıyorum ne katılmıyorum	Katılıyorum	Kesinlikle katılıyorum
Köpeğim için bazen planlarımı değiştirmek zorunda olmam sinir bozucudur.	1	2	3	4	5
Köpek sahibi olmanın ciddi ölçüde hoşlanmadığım tarafları var.	1	2	3	4	5
Köpeğimin, köpek sahibi olmadan önce yapmaktan keyif aldığım şeyleri yapmama engel olması canımı sıkıyor.	1	2	3	4	5
Köpeğim çok pahalıya mal oluyor.	1	2	3	4	5
Köpeğim ortalığı çok fazla batırıyor.	1	2	3	4	5
	Çok kolay	Kolay	Ne zor ne kolay	Zor	Çok zor
Köpeğinize bakmak ne kadar zor?	1	2	3	4	5

CBARQ

İlerleyen sayfalardaki sorular köpeğinizin yakın geçmişte nasıl davrandığını tanımlamanıza yardımcı olmak üzere tasarlanmıştır. Çalışmalar, bu soruların çoğunun, köpek mizacındaki değişkenlerin büyük kısmını tanımlayan ve farklı cinsiyet, ırk ve yaştan köpekler arasında görece tutarlılık gösteren 13 temel davranışsal özellik ya da faktör altında gruplanabileceğini göstermiştir:

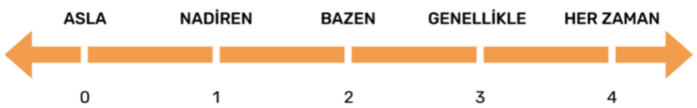
1. Yabancılara yönelik saldırganlık
2. Sahibine yönelik saldırganlık
3. Köpeklere yönelik saldırganlık
4. Eğitilebilirlik
5. Kovalama
6. Yabancı kaynaklı korku
7. Sosyal olmayan korku
8. Köpeğe yönelik korku
9. Ayrılıkla ilgili davranışlar
10. Dokunmaya karşı hassasiyet
11. Heyecanlılık
12. Bağlılık ya da ilgi çekmeye çalışma
13. Enerji

Lütfen tüm soruları cevaplamaya çalışın. 'Gözlemlenmedi/uygun değil' seçeneğini yalnızca tarif edilen davranışı köpekte hiç gözlemlemediyseniz işaretleyin.

Bölüm 1: Eğitim ve İtaat

Bazı köpekler diğerlerinden daha kolay eğitilebilirler. Aşağıdaki ölçekten uygun numarayı yazarak, köpeğinizin yakın geçmişte aşağıda belirtilen her bir durum için ne kadar eğitilebilir ve ya da itaatkar olduğunu belirtiniz.

Asla(0) - Nadiren(1) - Bazen(2)- Genellikle(3) - Her Zaman(4) Gözlemlenmedi/Uygun Değil



Tasması takılı değilken çağırıldığı zaman hemen geri döner.	
"Otur" komutuna hemen itaat eder.	
"Bekle" komutuna hemen itaat eder.	
Yaptığınız/söylediğiniz her şeyi dikkatle dinliyor gibi görünür.	
Düzeltme ya da cezalandırmaya geç tepki verir.	

İlginç görüntü, ses ya da kokulardan kolayca dikkati dağılır.	
Çubuk, top ya da nesneleri gidip getirir ya da gidip getirmeye çalışır.	

Bölüm 2: Saldırganlık

Bazı köpekler zaman zaman saldırgan davranışlar gösterebilirler. Köpeklerde tipik orta düzeyde saldırganlık belirtileri havlama, hırlama ve diş göstermedir. Daha ciddi saldırganlık davranışları genellikle kapma, üzerine saldırma, ısırma ve ısırmaya kalkışma olarak sıralanmaktadır. Ölçekten uygun numarayı ilgili kutuya yazarak, köpeğinizin yakın geçmişte aşağıda belirtilen durumlarda saldırgan davranış gösterme eğilimini belirtiniz.

Siz ya da başka bir aile üyesi tarafından sözlü olarak düzeltildiği veya cezalandırıldığı zaman (azarlanma, bağırılma vb.).	
Tasmayla yürütülürken/egzersiz yaparken yabancı bir yetişkin doğrudan yaklaşınca.	
Tasmayla yürütülürken/egzersiz yaparken yabancı bir çocuk doğrudan yaklaşınca.	
Arabanızdayken yabancı biri köpeğe yaklaşınca (örneğin benzin istasyonunda).	
Oyuncakları, kemikleri ya da diğer nesneler bir aile üyesi tarafından alındığında.	
Bir aile üyesi tarafından yıkandığında ya da tarandığında.	
Evdeyken size ya da ailenizin bir başka üyesine yabancı biri yaklaştığında.	
Ev dışındayken size ya da ailenizin bir başka üyesine yabancı biri yaklaştığında.	
Yemek yerken bir aile üyesi doğrudan yaklaştığında.	
Postacı ya da kargocular evinize yaklaştığında.	
Yemeği bir aile üyesi tarafından alındığında.	
Köpeğiniz dışarıda ya da bahçedeyken yabancılar evinizin önünden geçtiğinde.	
Yabancı biri köpeğe dokunmaya ya da onu sevmeye çalıştığı zaman.	
Koşucular, bisikletliler, patenciler ya da kaykaycılar, köpek bahçedeyken evinizin önünden geçtiği zaman.	

Tasmayla yürürken/egzersiz yaparken yabancı bir erkek köpek doğrudan yaklaşınca.	
Tasmayla yürürken/egzersiz yaparken yabancı bir dişi köpek doğrudan yaklaşınca.	
Bir aile üyesi doğrudan baktığında.	
Evinize gelen yabancı köpeklere karşı.	
Bahçenize giren kedi, sincap ya da başka hayvanlara karşı.	
Evinize gelen yabancı insanlara karşı.	
Yabancı bir köpek havladığında, hırladığında ya da saldırdığında.	
Bir aile üyesi atlayarak üzerinden geçtiğinde.	
Bir aile üyesi köpeğin çaldığı yiyecek ya da nesneleri geri aldığında.	
Evinizdeki tanıdık bir köpeğe karşı.	
Evinizdeki (tanıdık) başka bir köpek en sevdiği dinlenme/uyku alanına yaklaştığında.	
Evinizdeki (tanıdık) başka bir köpek yemek yerken yaklaştığında.	
Evinizdeki (tanıdık) başka bir köpek en sevdiği oyuncakla oynarken/oyuncağı, kemiği, nesneyi vb. çiğnerken yaklaştığında.	

Köpeğinizin zaman zaman saldırgan olduğu başka durumlar var mı? Varsa lütfen kısaca açıklayınız:

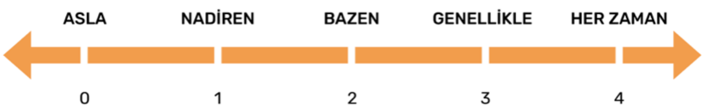
Bölüm 3: Korku ve Kaygı

Köpekler bazen çeşitli ses, nesne, insan ya da durumlara maruz kaldıklarında endişe ve korku belirtileri gösterebilirler. Tipik hafif ve orta korku, göz temasından kaçınma, korkulan nesneden kaçınma, kuyruğu alçalmış ya da bacaklarının arasına sıkıştırılmış şekilde çömelme, inleme ve ağlama, üşüme, titreme ve sarsılma. Aşırı korku; aşırı sinme, ve/veya gayretli bir şekilde kaçmaya yeltenme, korkulan nesneden, insandan ya da durumdan kaçınma veya saklanma olarak sıralanmaktadır. Ölçekten uygun numarayı ilgili kutuya yazarak, köpeğinizin yakın geçmişte aşağıda belirtilen durumların her birinde korku davranışı gösterme eğilimini belirtiniz.

Ev dışındayken yabancı bir yetişkin doğrudan yaklaştığında.	
Ev dışındayken yabancı bir çocuk doğrudan yaklaştığında.	
Ani ve gürültülü seslere karşı (örn. elektrikli süpürge, araba egzozu, yol kazısı gürültüsü, eşyaların düşürülmesi vb.)	
Yabancı kimseler evinizi ziyaret ettiğinde.	
Yabancı bir insan köpeğe dokunmaya ya da onu sevmeye çalıştığında.	
Yoğun trafikte.	
Kaldırımda ya da kaldırım kenarındaki bilinmeyen/tanıdık olmayan nesnelere karşı (örn. plastik çöp torbaları, yapraklar, çöp, dalgalanan bayraklar vb.).	
Bir veteriner tarafından muayene ya da tedavi edildiğinde.	
Gök gürültüsü, havai fişek gösterisi ya da benzer durumlarda.	
Aynı büyüklükte ya da daha iri yabancı bir köpek yaklaştığında.	
Daha küçük yabancı bir köpek yaklaştığında.	
Alışkın olmadığı durumlarla ilk kez karşılaştığında (örn. İlk araba yolculuğu, ilk kez asansöre binme, ilk veteriner ziyareti vb.)	
Rüzgara ya da rüzgarda uçan nesnelere karşı.	
Bir aile üyesi tarafından tırnakları kesildiğinde.	
Bir aile üyesi tarafından yıkandığında ya da tarandığında.	
Bir aile üyesi atlayarak üzerinden geçtiğinde.	
Bir aile üyesi tarafından patileri havluyla kurulandığında.	
Yabancı köpekler evinize geldiğinde.	
Yabancı bir köpek havladığında, hırladığında, ya da saldırdığında.	

Bölüm 4: Ayrılıkla İlişkili Davranış

Bazı köpekler kısa süreler için yalnız bırakılsalar bile kaygı ya da anormal davranış belirtileri gösterebilirler. Yakın geçmişi düşünerek, köpeğiniz yalnız bırakıldığında, ya da bırakılmak üzereyken aşağıdaki ayrılıkla ilişkili davranışlardan her birini ne sıklıkla gösterdi?



Titreme, ürperme, sarsılma	
Aşırı salya üretimi	
Tedirginlik, gerginlik, ya da volta atma	
Sızlanma/inleme.	
Havlama.	
Uluma.	
Kapı, zemin, pencere, perde vb. çiğneme ya da tırmalama.	
İştah kaybı.	

Köpeğinizin korkak ya da kaygılı olduğu başka bir durum var mı? Eğer varsa lütfen kısaca açıklayınız:

Bölüm 5: Heyecanlanma

Bazı köpekler ani ve olası heyecan verici olaylara ve çevredeki kargaşaya karşı görece az tepki gösterirken, bazıları en ufak bir yenilikte aşırı derecede heyecanlanır.

Hafif ve orta heyecanlılık belirtileri artan uyanıklılık/tetiklik, yeniliğin kaynağına doğru hareket ve kısa süreli havlamalar olarak sıralanmaktadır. Aşırı heyecanlılık ise genel bir aşırı tepki göstermeye meyillilik ile nitelendirilir. Heyecanlı köpek, en ufak bir kargaşada histerik şekilde havlar ve bağırır, heyecan kaynağına doğru ve etrafında hızlı bir şekilde koşar ve sakinleştirmesi zordur. Ölçekten uygun numarayı ilgili kutuya yazarak, köpeğinizin yakın geçmişte aşağıda belirtilen durumların her birinde heyecanlanma eğilimini belirtiniz.

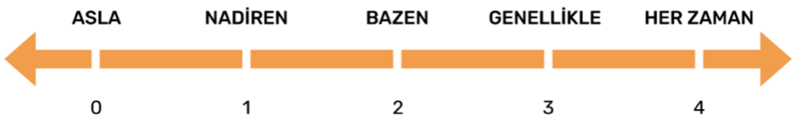
Siz ya da başka bir aile üyesi kısa bir yokluktan sonra eve döndüğünde.	
Sizinle ya da başka aile üyeleriyle oyun oynarken.	
Kapı zili çaldığında.	
Yürüyüşe çıkarılmadan hemen önce.	
Araba yolculuğuna çıkarılmadan hemen önce.	

Evinize ziyaretçiler geldiğinde.	

Köpeğinizin zaman zaman aşırı heyecanlı olduğu başka durumlar var mı? Varsa lütfen kısaca açıklayınız:

Bölüm 6: Bağlılık ve İlgi Çekmeye Çalışma

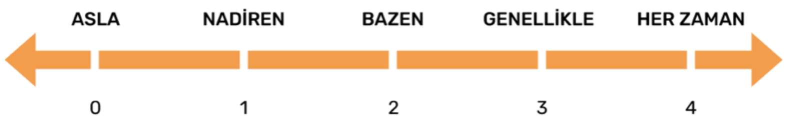
Çoğu köpek insanlarına güçlü bir şekilde bağlıdır ve bazıları insanlarından çok fazla ilgi ve sevgi bekler. Yakın geçmişi düşünerek, köpeğiniz aşağıdaki bağlılık ve ilgi çekmeye çalışma belirtilerinden her birini ne sıklıkla gösterdi?



Aile üyelerinden birine karşı güçlü bir bağlılık gösterir.	
Sizi (ya da diğer aile üyelerini) evde, odadan odaya takip etmeye meyillidir.	
Oturduğunuzda size (ya da diğerlerine) yakın, ya da temas halinde oturmaya meyillidir.	
Oturduğunuzda ilgi için sizi (ya da diğerlerini) dürtmeye, burnunu sürtmeye veya pati atmaya meyillidir.	
Siz (ya da diğerleri) başka bir insana ilgi gösterdiğinizde tedirgin olur (inler, zıplar, bölmeye çalışır).	
Siz (ya da diğerleri) başka bir köpeğe ya da hayvana ilgi gösterdiğinizde tedirgin olur (inler, zıplar, bölmeye çalışır).	

Bölüm 7: Çeşitli

Köpekler bu ankette bahsedilenlere ek olarak çok çeşitli davranış problemleri göstermektedirler. Yakın geçmişi düşünerek, köpeğinizin aşağıdaki davranışlardan her birini ne sıklıkla gösterdiğini belirtiniz:



Fırsat tanınırsa kedileri kovalar.	
Fırsat tanınırsa kuşları kovalar.	

Fırsat tanınırsa sincapları, tavşanları ya da diğer küçük hayvanları kovalar.	
Fırsat bulursa evden ya da bahçeden kaçar.	
Hayvan salgılarında ya da diğer “kokulu” maddelerde yuvarlanır.	
Kendi dışkısını ya da diğer hayvanların salgılarını ya da dışkılarını yer.	
Uygunsuz nesneleri çiğner.	
Nesnelerin, mobilyaların ya da insanların üzerine biner.	
İnsanlar yemek yerken ısrarlı bir şekilde yemek için yalvarır.	
Yiyecek çalar.	
Merdivenlerde gergin ya da korkmuştur.	
Tasması takılıyken tasmayı sert bir şekilde çeker.	
Evinizdeki nesne/eşyalara idrarını yapar.	
Yaklaşıldığında, sevildiğinde, ellendiğinde ya da kaldırıldığında/kucağa alındığında idrarını yapar.	
Gece ya da gündüz yalnız bırakıldığında idrarını yapar.	
Gece ya da gündüz yalnız bırakıldığında kakasını yapar.	
Hiperaktif, huzursuz ve sakinleşmesi güçtür.	
Oyuncu, yavru bir köpek gibi ve gürültücüdür.	
Aktif, enerjik ve sürekli hareket halindedir. ,	
Görünmez şeylere dikkatlice gözlerini dikerek bakar.	
(Görünmeyen) Sinekleri kapmaya çalışır.	
Kendi kuyruğunu/arkasını kovalar.	
Gölgeleri, ışık spotlarını vb. kovalar/takip eder.	
Paniğe kapıldığında ya da heyecanlıyken ısrarcı bir şekilde havlar.	
Kendini aşırı derecede yalar.	
İnsanları ya da nesneleri aşırı derecede yalar.	
Başka tuhaf, garip ya da tekrar eden davranış(lar) gösterir.	

*Kısaca açıklayınız:

F. Measurement Tools (English Versions)

MDORS

Subscale 1: Dog-Owner Interaction (Score scale: 9-45)	Never	Once in a month	Once in a week	Once in a few days	At least once a day
How often do you kiss your dog?	1	2	3	4	5
How often do you play games with your dog?	1	2	3	4	5
How often do you hug your dog?	1	2	3	4	5
	Never	Once in a yer	Once in a month	Once in a week	Once a day
How often do you take your dog to visit other people?	1	2	3	4	5
	Never	Twice in a year	Once in a month	Once in two weeks	Once in a week
How often do you buy your dog presents?	1	2	3	4	5
	Never	Once in a month	Once in a week	Once in a few days	At least once a day
How often do you give your dog food treats?	1	2	3	4	5
How often do you get in the car with your dog?	1	2	3	4	5
How often do you comb your dog?	1	2	3	4	5

	Never	Twice in a year	Once in a month	Once in two weeks	Once in a week
How often do you have your dog while relaxing (i.e. watching TV)?	1	2	3	4	5
Sub Scale 2: Emotional Closeness (Score scale: 10-50)	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
My dog helps me get through though times.	1	2	3	4	5
My dog is there whenever I need to be comforted.	1	2	3	4	5
If everyone else left me, my dog will still be there for me.	1	2	3	4	5
I would like to have my dog near me all the time.	1	2	3	4	5
My dog provides me with constant companionship.	1	2	3	4	5
My dog is constantly attentive to me.	1	2	3	4	5
My dog gives me a reason to get up in the morning.	1	2	3	4	5
I wish my dog and I never had to be apart.	1	2	3	4	5
	Never	Once in a month	Once in a week	Once in a few days	At least once a day
How often do you tell your dog things you don't tell anyone else?	1	2	3	4	5
	Not traumatic at all	Not traumatic	Neutral	Traumatic	Very traumatic
How traumatic do you think it will be for you when your dog dies?	1	2	3	4	5

Sub Scale 3: Perceived Costs (Score scale: 9-45)	Never	Once in a year	Once in a month	Once in a week	Once in a day
How often do you feel that looking after your dog is a chore?	1	2	3	4	5
How often does your dog stop you doing things that you want to do?	1	2	3	4	5
How often do you feel that having a dog is more trouble than it is worth?	1	2	3	4	5
	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
It is annoying that I sometimes have to change my plans because of my dog.	1	2	3	4	5
There are major aspect of owning a dog I don't like.	1	2	3	4	5
It bothers me that my dog stops me doing things that I enjoyed doing before I owned it.	1	2	3	4	5
My dog costs too much money.	1	2	3	4	5
My dog makes too much mess.	1	2	3	4	5
	Very easy	Easy	Neither hard nor easy	Hard	Very hard
How hard is to look after your dog?	1	2	3	4	5

CBARQ

The questions on the following pages are designed to allow you to describe how your dog has been behaving in the recent past. Studies have shown that most of these questions can be grouped or condensed into a set of thirteen major behavioral traits or factors that describe most of the variation in canine temperament, and which are relatively consistent across dogs of different sexes, breeds, and ages:

1. Stranger-directed aggression
2. Owner-directed aggression
3. Dog-directed aggression/fear
4. Trainability
5. Chasing
6. Stranger-directed fear
7. Nonsocial fear
8. Dog-directed fear
9. Separation-related behavior
10. Touch sensitivity
11. Excitability
12. Attachment or attention-seeking
13. Energy

Please try to answer all of the questions. Only use the "not observed/not applicable" option if you have never observed the dog in the situation described.

Section 1: Training and obedience

Some dogs are more trainable than others. By writing in the appropriate number from the scale, please indicate how trainable or obedient your dog has been in each of the following situations in the recent past.

Never(0) - Seldom(1) - Sometimes(2)- Usually(3) - Always(4) – Not observed/Not applicable(N/A)

When off the leash, returns immediately when called.	
Obeys the "sit" command immediately.	
Obeys the "stay" command immediately.	
Seems to attend/listen closely to everything you say or do.	
Slow to respond to correction or punishment; "thick-skinned".	

Slow to learn new tricks or tasks.	
Easily distracted by interesting sights, sounds, or smells.	
Will "fetch" or attempt to fetch sticks, balls, or objects.	

Section 2: Aggression

Some dogs display aggressive behavior from time to time. Typical signs of moderate aggression in dogs include barking, growling and baring teeth. More serious aggression generally includes snapping, lunging, biting, or attempting to bite. By writing in the appropriate number from the scale, please indicate your own dog's recent tendency to display aggressive behavior in each of the following contexts:.

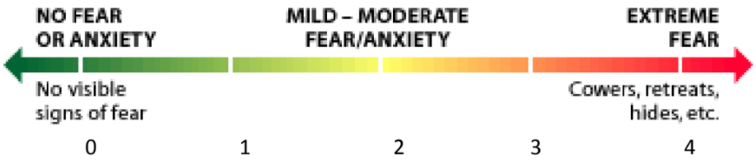
When verbally corrected or punished (scolded, shouted at, etc.) by you or a household member.	
When approached directly by an unfamiliar adult while being walked/exercised on a leash.	
When approached directly by an unfamiliar child while being walked/exercised on a leash.	
Toward unfamiliar persons approaching the dog while s/he is in your car (at the gas station, for example).	
When toys, bones or other objects are taken away by a household member.	
When bathed or groomed by a household member.	
When an unfamiliar person approaches you or another member of your family at home.	
When unfamiliar persons approach you or another member of your family away from your home.	
When approached directly by a household member while s/he is eating.	
When mailmen or other delivery workers approach your home.	
When his/her food is taken away by a household member.	
When strangers walk past your home while your dog is outside or in the yard.	
When an unfamiliar person tries to touch or pet the dog.	

When joggers, cyclists, rollerbladers or skateboarders pass your home while your dog is outside or in the yard.	
When approached directly by an unfamiliar male dog while being walked/exercised on a leash.	
When approached directly by an unfamiliar female dog while being walked/exercised on a leash.	
When stared at directly by a member of the household.	
Toward unfamiliar dogs visiting your home.	
Toward cats, squirrels or other animals entering your yard.	
Toward unfamiliar persons visiting your home.	
When barked, growled, or lunged at by another (unfamiliar) dog.	
When stepped over by a member of the household.	
When you or a household member retrieves food or objects stolen by the dog.	
Towards another (familiar) dog in your household.	
When approached at a favorite resting/sleeping place by another (familiar) household dog.	
When approached while eating by another (familiar) household dog.	
When approached while playing with/chewing a favorite toy, bone, object, etc., by another (familiar) household dog.	

Are there any other situations in which your dog is sometimes aggressive? If so, please describe briefly:

Section 3: Fear and anxiety

Dogs sometimes show signs of anxiety or fear when exposed to particular sounds, objects, persons or situations. Typical signs of mild to moderate fear include: avoiding eye contact, avoidance of the feared object, crouching or cringing with tail lowered or tucked between the legs, whimpering and whining, freezing, and shaking and trembling. Extreme fear is characterized by exaggerated cowering, and/or vigorous attempts to escape, retreat or hide from the feared object, person or situation. By writing in the appropriate number from the scale, please indicate your own dog's recent tendency to display fearful behavior in each of the following contexts:



When approached directly by an unfamiliar adult while away from your home.	
When approached directly by an unfamiliar child while away from your home.	
In response to sudden or loud noises (e.g. vacuum cleaner, car backfire, road drills, objects being dropped, etc.).	
When unfamiliar persons visit your home.	
When an unfamiliar person tries to touch or pet the dog.	
In heavy traffic.	
In response to strange or unfamiliar objects on or near the sidewalk (e.g. plastic trash bags, leaves, litter, flags flapping, etc.).	
When examined/treated by a veterinarian.	
During thunderstorms, firework displays, or similar events.	
When approached directly by an unfamiliar dog of the same or larger size.	
When approached directly by an unfamiliar dog of smaller size.	
When first exposed to unfamiliar situations (e.g. first car trip, first time in elevator, first visit to veterinarian, etc.).	
In response to wind or wind-blown objects.	
When having nails clipped by a household member.	
When groomed or bathed by a household member.	
When stepped over by a member of the household.	
When having his/her feet toweled by a member of the household.	
When unfamiliar dogs visit your home.	
When barked, growled, or lunged at by an unfamiliar dog.	

Section 4: Separation-related behavior

Some dogs show signs of anxiety or abnormal behavior when left alone, even for relatively short periods of time. Thinking back over the recent past, how often has your dog shown each of the following signs of separation-related behavior when left, or about to be left, on its own:

Shaking, shivering, or trembling.	
Excessive salivation.	
Restlessness, agitation, or pacing.	
Whining.	
Barking.	
Howling.	
Chewing or scratching at doors, floor, windows, curtains, etc.	
Loss of appetite.	

Are there any other situations in which your dog is fearful or anxious? If so, please describe briefly:

Section 5: Excitability

Some dogs show relatively little reaction to sudden or potentially exciting events and disturbances in their environment, while others become highly excited at the slightest novelty. Signs of mild to moderate excitability include increased alertness, movement toward the source of novelty, and brief episodes of barking. Extreme excitability is characterized by a general tendency to over-react. The excitable dog barks or yelps hysterically at the slightest disturbance, rushes toward and around any source of excitement, and is difficult to calm down. By writing in the appropriate number from the scale, please indicate your own dog's recent tendency to become excitable in each of the following contexts:

When you or other members of the household come home after a brief absence.	
When playing with you or other members of your household.	
When doorbell rings.	

Just before being taken for a walk.	
Just before being taken on a car trip.	
When visitors arrive at your home.	

Are there any other situations in which your dog sometimes becomes over-excited? If so, please describe briefly:

Section 6: Attachment and attention-seeking

Most dogs are strongly attached to their people, and some demand a great deal of attention and affection from them. Thinking back over the recent past, how often has your dog shown each of the following signs of attachment or attention-seeking:

Displays a strong attachment for one particular member of the household.	
Tends to follow you (or other members of the household) about the house, from room to room.	
Tends to sit close to, or in contact with, you (or others) when you are sitting down.	
Tends to nudge, nuzzle or paw you (or others) for attention when you are sitting down.	
Becomes agitated (whines, jumps up, tries to intervene) when you (or others) show affection for another person.	
Becomes agitated (whines, jumps up, tries to intervene) when you (or others) show affection for another dog or animal.	

Section 7: Miscellaneous

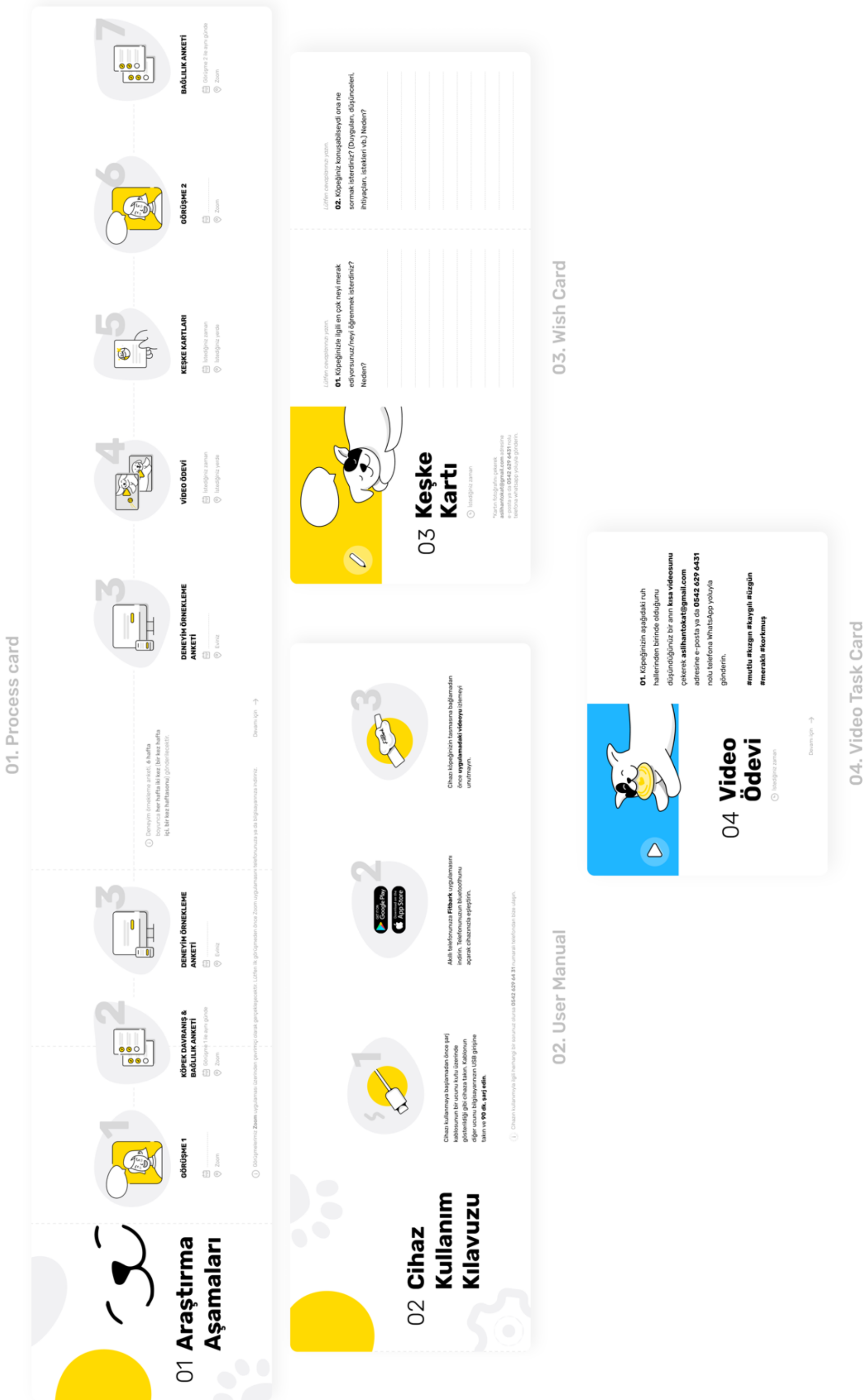
Dogs display a wide range of miscellaneous behavior problems in addition to those already covered by this questionnaire. Thinking back over the recent past, please indicate how often your dog has shown any of the following behaviors:

Chases or would chase cats given the opportunity.	

Chases or would chase birds given the opportunity.	
Chases or would chase squirrels, rabbits and other small animals given the opportunity.	
Escapes or would escape from home or yard given the chance.	
Rolls in animal droppings or other "smelly" substances.	
Eats own or other animals' droppings or feces.	
Chews inappropriate objects.	
"Mounts" objects, furniture, or people.	
Begs persistently for food when people are eating.	
Steals food.	
Nervous or frightened on stairs.	
Pulls excessively hard when on the leash.	
Urinates against objects/furnishings in your home.	
Urinates when approached, petted, handled or picked up.	
Urinates when left alone at night, or during the daytime.	
Defecates when left alone at night, or during the daytime.	
Hyperactive, restless, has trouble settling down.	
Playful, puppyish, boisterous.	
Active, energetic, always on the go.	
Stares intently at nothing visible.	
Snaps at (invisible) flies.	
Chases own tail/hind end.	
Chases/follows shadows, light spots, etc.	
Barks persistently when alarmed or excited.	
Licks him/herself excessively.	
Licks people or objects excessively.	
Displays other bizarre, strange, or repetitive behavior(s).*	

*Describe briefly:

G. Study Cards



CURRICULUM VITAE

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Nationality: Turkish (TC)

EDUCATION

Degree	Institution	Year of Graduation
MS	METU Industrial Design	2017
BS	METU Industrial Design	2012
Erasmus Exchange Student	Kunsthochschule Kassel	2010
High School	Çankaya Milli Piyango Anatolian High School, Ankara	2006

WORK EXPERIENCE

Year	Place	Role
2023-present	Insider	User Experience Researcher
2021-present	Petware Technology	Co-founder
2020-2022	Designware	Freelance Designer
2018-2023	METU	Research Assistant
2016-2018	TOBB ETÜ	Research Assistant
2015-2015	TOBB ETÜ	Instructor
2013-2014	Designnobis	Product Designer
2011-2013	REO-TEK	Product Designer

FOREIGN LANGUAGES

Advanced English, Intermediate German

PUBLICATIONS

Tokat, A. (2021). Exploring the Potentials of Dog Activity Monitoring Systems for Improving the Human Caregiving of Dogs through Increasing Awareness. In *the Proceeding of Eight International Conference on Animal-Computer Interaction*, 1–4. https://doi.org/10.1145/3493842.3493899

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