Understanding Animals: A Critical Challenge in ACI

Fredrik Aspling
Department of Computer and Systems Sciences
Stockholm University, Sweden
aspling@dsv.su.se

Oskar Juhlin
Department of Computer and Systems Sciences
Stockholm University, Sweden
oskarj@dsv.su.se

Heli Väätäjä
Tampere University of Technology
Tampere, Finland
heli.vaataja@uta.fi

ABSTRACT

We present a qualitative content analysis of visual-verbal social media posts, where ordinary dog owners pretend to be their canine, to identify meaningful facets in their dogs' life-worlds, e.g. pleasures of human-dog relation, dog-dog relations, food etc. We use this knowledge to inform design of "quantified pets". The study targets a general problem in Animal-Computer Interaction (ACI), i.e. to understand animals when designing "for" them, although lacking a common language. Several approaches, e.g. ethnography and participatory design, have been appropriated from HCI without exhausting the issue. We argue for a methodological creativity and pluralism by suggesting an additional approach drawing on "kinesthetic empathy". It implies to understand animals by empathizing with their bodily movements over time and decoding the realities of their life-worlds. This, and other related approaches, has inspired animal researchers to conduct more or less radical participant observations during extensive duration to understand the perspective of the other. We suggest that dog owners whom share their lives with their dogs already possess a similar understanding as these experts, and thus uphold important experiences of canine life that could be used to understand individual dogs and inspire design.

Author Keywords

Animal-Computer Interaction; Quantified Pets; Dog Blogs; Social Media; Kinesthetic Empathy; Pet Dogs;

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

In recent years, we have seen an emergent design interest in smart computing and sensing technologies to monitor different types of animals (e.g. [24]), especially pet dogs [2, 6, 7, 8, 9, 37, 50]. Ideas for such systems tend to be generated from interviews with dog owners about their experiences and expectations of such technologies [43, 44]. These studies revealed that the dog owners were interested in monitoring physical aspects of their dogs, e.g. physical activity, barking, heart rate, stress level, body temperature, hunger, growth, location, and what their dogs was doing in home alone scenarios. Similar projects focus on monitoring dogs' caloric input/outputs, as well as exercise and movement habits [41]. Other topics concern identifying physical behaviors such as chewing barking, pawing, and sniffing with collar-worn sensors [25], or computer vision [1]. Consumer oriented activity trackers directed towards companion dogs (e.g. FitBark, PetPace, Whistle) measures physical activity and wellbeing of pet dogs with sensors such as GPS, accelerometer and gyroscope. Other commercially oriented sensing technologies even promises to report on the dogs' emotional state by measuring and interpreting tail motion (e.g. TailTalk). In all, the general motivation is to increase the dogs' wellbeing, and advance knowledge for caretakers and veterinarians about the animals.

This emergent orientation co-occurs with personal informatics and the so called "quantified self"-movement and its determination to generate "self-knowledge through numbers" [55]. It engages the use of sensing technologies for collecting and analyzing quantitative and longitudinal data of several aspect of behaviors and performances of the human self. The research interest in this movement, has been to understand these users in terms of their practices, motivations, and encountered problems to generate design implications (e.g. [24; 31; 46]). Given this desire to measure human life, it is not so strange that animals and especially pet dogs whom many of us share our lives with, are addressed. Although, currently in a constrained manner, limited to a "physical health paradigm" or early ideas, such as measuring dogs' emotional states. However, there is probably more to dogs' wellbeing than physical health, and likewise a need to explore new topics and their measurability.

In HCI, there is a growing body of research on Animal-Computer Interaction (ACI) where the specific concern of widening the design scope in "quantified pets" has been acknowledged (e.g. [25, 41, 43, 44]) and problematized [28, 29, 34]. From a critical perspective it is argued that such technology can risk to decrease or even replace owners' ability to interpret their dogs' behavior, and consequently disrupt human-animal relationships and animal welfare

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[28]. Furthermore, it is argued that commercially available products lack foundation in animal behavior science, and that their promises tend to be impractical and unreliable (e.g. measuring dog emotion) [29]. There is always a need to be skeptical and critical, especially of risky and improbable design ideas and their unintended consequences. For quantified pets there is a need to be extra cautious, especially if the systems lack validity and primary becomes gadgets for humans where the animals' perspectives and well-being becomes secondary.

The topic of designing quantified pets depends on understanding animals. This is fundamental for ACI that even has extended the ambition to design "for" animals [33], which in this case would translate to understand what animals would like to convey to humans. Such a project is obviously difficult due to interspecies differences and communicative barriers. The interaction between humans and canine is foremost pursued through nonverbal communications, such as posture and gaze (e.g. [16]). Lacking a common language is a challenge when figuring out what would be a meaningful quantification. Despite the epistemological and intrinsic problems of understanding the wants and needs of animals, such as pet dogs, there is still a need for the field to seriously consider and creatively explore the opportunities and challenges related to this inquire.

As a way to address the challenge to unpack user demands, and similar to research within HCI, some researchers have turned to participatory design (e.g. [18, 53]). The method suggests to overcome the challenge by involving the user directly in the design process rather than relying on the designer's knowledge of the user [18]. However, the reported studies articulate user demands rather superficially, and they fail to explain how animals act as designers. We argue that ACI should strive to creatively and cautiously explore additional methods and approaches, to get closer to an understanding of what animals might want and consider as meaningful, in order to ground design closer to their own needs and interests.

An important point of inspiration can be found in animal studies, where several scholars take into account 'the point of view' of the animals they observe (e.g. [19, 39, 49]). This approach has developed over the last three decades, and has been defined as a radical shift by philosopher Vinciane Despret [10, 11]. It provides more reliable descriptions, and most importantly for ACI, they identify behaviors that presumably are the most meaningful for the animals. A similar approach is found in Shapiro's autoethnographic work and his idea of "kinesthetic empathy" [48], in which a person attempts to empathize with an animal by understanding their bodily experiences over time and their personal history, and then tries to understand the human-dog relationship from the dogs perspective (rather than the other way around). Such an approach, where understanding rests on long term and situated experiences, could be fruitful to generate design ideas about what matters for animals and what they possibly could find important. We argue that ordinary dog owners develop a kind of kinesthetic and biographical empathy as they are intimately involved in long term interaction with their canines. They are naturally involved in their dogs' lives and interact with them under similar circumstances as with other family members.

Besides discussing how such a methodology could be useful for ACI, we have been interested in analyzing such an approach when its adopted by ordinary dog owners in social media where they create profiles for their pets and share posts from their dogs' "point of view". Although being problematic in terms of e.g. being anthropomorphic and humoristic in various grades, these posts offer a rich empirical material of canine life. They involve detailed and continual accounts of different significant aspects related to canine life in a broad range of mundane everyday scenarios.

We are especially interested in exploring to what extent these posts can help us to ask questions of what matters for the animals, and to what extent they can help us to identify what that possibly can be important when it comes to design for them. Hence, if the data can help us answer questions on what to quantify in canine life that actually is meaningful and could benefit the dogs. The analysis reveals that the dogs' perspectives and experiences, when imagined by their owners, is concerned with ordinary things like social relations with other dogs as well as humans; spatiality and the physical environment; physical objects; emotional attitudes and various set of ordinary activities. This implies that design of "quantified pets" should focus on the mundane and ordinary aspects of everyday dog life. Sensor technologies can potentially be an effective way to slowly build an increased empathy for their canine companions, both in terms of a sensibility towards physical expressions and experience, as well as building and logging a biographical understanding over time.

RELATED WORK

In this section, we reflect upon methodological approaches in ACI for understanding animals. We also discuss the method of dwelling into the presence of other animals to reveal what they find important and meaningful.

Methods to include animals' needs in design

There is a growing interest to design information technology for animals of various kinds, as expressed in the formulation of a research area called Animal-Computer Interaction (ACI). An important design intent, is the ambition to design for and with animals [33, 35, 36]. The ambition is to diverge from design that utilizes technology and animals in the sole interest of humans. The ambition is aligned with a general ambition in HCI to understand and capture users' needs and develop them into systems requirements [45], i.e. to identify, describe and analyze relevant aspects of user experiences so that design is adequately informed. Obviously, it is quite a challenge to understand what the animals want to have, and how computer systems could provide such services. It is a

challenge since we still struggle with the same topic also when it comes to our own species. Although dogs do not communicate with us in our language, we still communicate with each other with various signals, vocalizations and body postures, for example. As the common language is learned on both sides, this creates a challenge to overcome in design activities (e.g. [15, 53]).

A small number of studies in ACI focus on the topic of unpacking animal practices e.g ethnographic observations of hunting [3, 52] and video analysis of dog walking [2]. Taken together, these studies reveal interesting aspects of, in particular, canine life. At the same time, the methodologies have their weaknesses. Ethnographic observations build on limited experiences, and video analysis risks missing experiential aspects, which are not empirically available in interaction. Interviews with e.g. dog owners (e.g. [28, 43, 44]) is a commonly applied method, but it risk to provide more or less anthropocentric generalizations with limited value of design, or not being valid descriptions.

Similar to research within HCI, several researchers have turned to design, e.g. participatory design, speculative design and research through design, as a way to address the challenge of unpacking user demands at the same time as designing "for" the user. Participatory design has been adopted in a number of projects (e.g. [18, 35, 53]). The method suggests to overcome the challenge by "…involving the user directly in the design process rather than relying on the designer's knowledge of the user" [18]. Such co-design builds on two different sharing principles i.e. "…shared language between the designer and the user, or on that the designer can reasonably transfer her own experiences with a designed object to those of her users" [18]. The designer increases the understanding of the user by observing what they do i.e. participant observation. Equally, important, the user learn about the design possibilities, e.g. new technologies, from the designer and can thereby themselves articulate their demands and suggest solutions. Some of these ACI studies do report on designers' "observations" [18], such as the practices of cancer detection dogs and playful interaction. Unfortunately, such learnings are not in focus in the reported studies. More important, they lack articulations of how the animals express their demands or suggested solutions. Again, it is demonstrated that the dogs take part in joint activities, such as smelling cancer samples [20, 35] or creative play [53]. But there is nothing presented that indicates that the animals are active in doing and contributing to design work, as it is conceived in participatory design. Hammeleff et al. [18] even note, in the most methodologically elaborate study on this topic, that the animals' engagement "… is not necessarily in the form of intentional or functional alteration or modification but in the form of playful exploration of the environment." Thus, the reported design work that is presented as "participant design" does not have its focus on articulating user demands and at the same time conflate participation in play with participation in design, which leave us with a remaining problem of understanding the user.

Another way of handling the problem is to avoid attempts to understand animals in advance of engaging in design. This approach is turned speculative design. Lawson et al. [28] use it as a way to speculate about possible systems with reference to existing commercial products of quantified pet applications. In the study, they explore attitudes towards such systems by interviewing pet owners and animal experts. It revealed that pet owners were uncritically interested in technologies that e.g. could detect emotions of their dogs, while animal experts where highly critical of such technologies. However, such proposed system is explicitly intended for dog owners and not for the animals. In another paper [29], Lawson et al. speculate about technology designed by dogs and how such technology could look like and be used. They ground their speculations in dogs cognitive and communicative abilities. This approach is envisioned to explore "how technology may support the agency of the animal, so that they can genuinely be considered users" [Ibid., p. 40]. These speculations are intendedly close to the animal as user but they are not grounded in empirical observations. Speculative approaches have also been used as a means to imagine life as experienced by animals and design systems meaningful for them [42]. The latter two papers (i.e. [29; 42]) are also argued as a way to illustrate the dangers and absurdity of trying to co-design with the "voiceless".

In sum, in sharing the ambition to design for and with animals, we are constrained by existing ACI methods to understand animals, or stuck between either speculations or overstating their participation in design. All contributions are of course legitimate since the challenge is hard. This leads us to call for increased methodological creativity. For example, we suggest that an alternative approach to acquire such knowledge can be found by articulating human experience of sharing life with canines.

Kinesthetic empathy and the animals' perspectives

We have emphasized the need of understanding animals in order to design for them. As we have seen in the previous section there are different methods and approaches of doing so, such as participatory design (e.g. [18, 53]). Another way is to imagine life from the dog's perspective. As proclaimed by Despret [10, 11], observations of animals with such an approach opens up for different questions and identifies behaviors that presumably are of meaningful value for the animals. Thus, to develop meaningful design for animals we should orient towards the animals' subjective lifeworlds, i.e. "where things, activities, relations, and events have experiential significance" [9, p. 89].

A radical example is explored by Foster [14] where he describes his experiences of trying to live as different wild animal in their natural surroundings. As noted by Sanders [47], dwelling into other animal's perspective is also done

by regular dog owners as they sometimes are found in situations where they must "speak for" their "mute" companion. As such, "they make use of a rich body of knowledge derived from an intimate understanding of the animal-other built up in the course of day-to-day experiences" [47, p. 17].

Even if scientific advancement has increased the awareness of animal consciousness and subjectivity [17], as well their emotional lives [4], there is still skepticism regarding what we can know what it is like to be another species (e.g. [40, 51]). This epistemological dilemma is evidently problematic for ACI and its ambition to treat animals as stakeholders of design. When designing for animals without human utilitarian agendas we are confronted with the intriguingly difficult quest, namely to interpret and evaluating their subjective experiences, individual demands and likes. Something that to a large extent involves various degrees of anthropomorphism. Instead of avoiding or taking an agnostic approach of such enquires, we should at least aim towards an open-minded - and equally skeptical - attitude to what they might be experiencing. In doing so we should encompass and evaluate all possible resources.

Indeed, it is impossible to completely enter the mind of another animal. However, symbolic interactionism and as well as social phenomenology argues that mind is not exclusively inside the head, it is also a "social accomplishment" [16, p. 123]. Cognitive ethologists, such as Beakoff, argues that animals' emotions are visible for observers [4]. From such standpoints, it is understood that action always is minded and subjectively meaningful, and that such meaning is accessible. This is something that is shared by ethnomethodology (e.g. [2; 16]), where the subjective lifeworlds of actors (in terms of e.g. experiences and intentions) are not restricted to being inside their heads, but emerges and is exposed in regular interactions, by paying close attention to the bodily details. Such accounts on human-animal interaction have previously focused on leashed interaction [2, 27] and play [16].

Shapiro's idea of "kinesthetic empathy" combined with a biographical sensibility [48], broadens such accounts. Sharing a close attention to bodily details, kinesthetic empathy adds a biographical understanding of individual dogs. It involves an understanding of individual dogs' and their bodily expressions in specific contexts and over time. It adds an important dimension to this kind of enquires of understanding and observing accountable aspects of the dogs' experiential lifeworlds. Building an understanding of canines' bodily expressions in shared situations over time increases the bond and understanding for each other in the human-canine relationship. Ordinary dog owners whom closely share their lives and households with their canines, potentially, and to various degree, develop such an empathy with their dogs. There are different ways of embody the animals experience, e.g. to see imagine life "from inside" with minimal or none interference, or to increase interference by "'undo and redo' their own bodies in order to interact more closely with the observed animals and respond to them more cautiously" [11, p. 51]. Dog owners obviously belongs to the latter, which can upsurge a kinesthetic empathy.

In sum, we argue for a need of grounding ideas for design in detailed empirical observations that e.g. reveals meaningful facets of the animals' lifeworlds. Such understanding emerges in situated and long-term experiences. This is not only is possessed by observing scientists, such as ethologists and ethnographers, but is also accessible to regular dog owners.

METHOD AND SETTING

We propose a new and additional methodological approach to the field of ACI, which draws on the theory presented in the previous section. Instead of engaging in demanding participant observation (e.g. [16, 14]), we analyze already available ethno-accounts. We provide a qualitative content analysis of social media posts by dog profiles where dog owners give voice to their dog by interpreting and imagining life from their dogs' perspectives. As a methodological starting point, we considered these posts as expressing some kind of kinesthetic empathy and a biographical understanding of the dogs, which could be worth to investigate and evaluate. In this paper, we focus on investigating what core facets of the dogs' lifeworld that can be identified in such posts when looking beyond the most obvious layers of anthropomorphism. We are doing so to generate ideas for "quantified pets". In the following we describe the method and setting of the study in more detail.

Dog profiles on Instagram and Facebook

The phenomenon sometimes called "social petworking" or "dog blogging", where dog owners create a social media profile for their pet and imagine life from their point of view, is a popular trend on e.g. Instagram and Facebook. Typically, by sharing photographs of their dog in mundane everyday scenarios with a caption that "gives voice to" and imagines life from "the dogs' perspective". Hence, this phenomenon is different compared to owners posting about their pet from their personal social media account, or people sharing animal memes for sole humoristic purposes (e.g. [12]).

There are no exact figures on the amount of dog profiles in social media. In a survey by Mars PetCare US [32] from 2017, two thousand pet owners and social media users were asked about how their pets are involved in social media. This can give an indication of the proportion of the phenomena. Around 65 percent of them posted about their pets twice a week. One out of six (21 per cent) had a profile for their pet, and half of these stated that their pets get more response from the public than their personal profiles. One third (33 per cent) reported that post about their pets as much as they do about their human family, and 13 percent admitted to posting about their pets even more than they do about their human family. Different hashtags on Instagram can also give an indication of the phenomenon's proportion, e.g. *#dogblog* and *#dogsofinstagram* had about 200 000

respectively over 100 million posts by the end of June 2018. However, not all the tagged posts are by dog profiles, neither are all dog profiles filed under the same tag.

Despite the ambition to the dwell into the dogs' perspectives, dog blogging is obviously biased by a human perspective. It is doubtful to what extent they reveal the truth about the dogs, and if the interpretation of the dogs' perspectives is valid. It is also unclear if the dog owners themselves consider their interpretations as valid and their degree of seriousness in the activity. This human bias tends to be exaggerated, many times as a form of humor that could be defined as "joyful anthropomorphism", which simultaneously expresses a large proportion of love, affection and care for the dogs.

Posts by dog profiles are apparently staged, but they do provide naturalistic data of people pretending to be their pets, which is rare to find elsewhere. This practice is indeed a very human practice, not only in terms of being anthropomorphic. It has also been argued that dog blogging is anthropocentric, and is more about the humans than about the dogs [30]. Besides reporting on their dogs' lives, activities, experiences and emotions, it can "convey the humans' emotional attachment to dogs, and to provide information and entertainment to likeminded dog lovers" [Ibid., p. 64]. Dog blogs offers an additional space for socializing with other humans, which can have a similar effect as the social benefits of pet keeping in general (e.g. [54]). Despite this anthropocentric dimension of dog blogging, it lets the owners imagine and reflect upon themselves and their interactions with their dogs from "their dogs' perspectives". This kind of imaginative and role-taking exercise can disclose and lead to contemplations on what kind of dog owners they are and would like to be? Their engagement as caretakers? What they are doing with their dogs? What their dogs like and dislike? It is a reflective practice that can influence their behavior and identity as dog owners, as well as their kinesthetic and biographical empathy towards their dogs.

Dog blogging is an emerging and interesting phenomenon in many ways which needs further investigations. In this study, we have been interested in what kind of aspects in the dogs' life that the visual-verbal content of these posts expose. When dog owners, whom intimately are sharing their lives with their dogs intend to dwell into their presence, what aspects of the dogs' lifeworlds do they, consciously or unconsciously, choose to reveal?

A qualitative content analysis of posts by dog profiles

Qualitative content analysis is a research method to systematically analyze and identify patterns and structures in different types of content [23]. In HCI, this method has foremost been used to categorize and analyze user-generated content (e.g. [22]), but also to apply more interpretative and humanistic approaches influenced by critical theory (e.g. [5]). Our approach makes no effort to go beyond the content to analyze the discursive means of how dogs are represented in these posts (e.g. [30]). In this paper, we have bracketed such ambitions and restricted our investigation to explore what core facets in the dogs lifeworlds that can be identified in these posts when the most obvious layer of anthropomorphism is unwrapped. This focus is chosen in alignment with the ambition to generate ideas and topics for "quantified pets" grounded in what may be interesting and meaningful in the dogs lifeworlds as imagined by their human caretaker.

Sampling and data

The data consists of 60 systematically sampled visual-verbal posts by 20 public dog profiles on social media, i.e. Instagram and Facebook, with a symmetrical distribution embracing 10 profiles from each application. We have collected the last three posts from each sampled profile available on August the 25th (Instagram) and 26th (Facebook), 2017. All profiles have been judged according to the sampling criteria of being authored by dog owners pretending to be their dogs. Posts on such profiles present the same dog in a multitude of settings and situations and use the dogs' name or nickname. There are commonly details about the dog (e.g. breed, birthdate, city, caretaker) in the profile information. Furthermore, our sampling criteria is restricted to posts where the users share a single image. Posts with videos, multiple images, only text, and other types of posts have been excluded. The data set includes posts in terms of image, caption and comments by other human and dog profiles.

The posts on both forums have been systematically sampled through a "controlled snowball sampling". The same sampling strategy was applied for both applications. First, we identified relevant hashtags (e.g. *#dogblog, #dogblogs, #dogblogging and #dogsofinstagram*) that we assumed that posts by dog profiles could be ascribed with. It seemed that a large variety of hashtags was used for this phenomenon. Two weeks later, on the dates mentioned above, we started the data collection by revisiting each forum and searched for the hashtag *#dogblog*. We used the first dog profile in the search result that fulfilled our sampling criteria as the point of departure for our data collection, and sampled the latest three posts from that profile. The next profile was selected by visiting the newest of these posts and looked for the very first dog profile in the commentary thread. We did this process three times before actually sampling posts from the next profile to generate a more scattered data set. We continued this process until 30 posts for each application was reached. It could have been possible to collect a randomized sample of posts under a specific hashtag, but it would restrict the data to a specific single hashtag. With this technique we could capture posts filed under several relevant hashtags.

Coding and analyze

The data was coded inductively in order to identify what facets in the dogs' lifeworld these posts depicts by analyzing the content explicatory and semantically, without any intention to reveal underlying or discursive meanings.

DATA	FACETS IN DOG LIFE						
	Physical	**Temporal**	**Relational**	**Bodily**	**Situational**	**Inner**	**Superficial**
Verbal	- Physical surroundings - Weather conditions - Physical artifacts - Food and treats	- Past - Present - Future	- Dogs relation to humans - Dogs relation to other dogs - Dogs relation to other animals	- Body movement - Body posture - Facial expressions	- Activities - Events	- Emotion/mood - Attitudes	- Breed - Appearance - Aesthetics - Fashion
Visual	- Physical surroundings - Weather conditions - Physical artifacts	- N/A	- Single Dog - Dog-dog/s - Dog/s-human/s - Dog-other animals	- Body movement - Body posture - Gaze - Facial expressions	- N/A	- N/A	- Breed - Appearance - Fashion

Table 1: Overview of facets in dogs' lifeworlds identified in posts by dog profiles on Instagram and Facebook.

The visual images and the verbal interpretations were coded independently, and thereafter categorized in accordance to find a comparable categorical language for both types of data. The coding and categorizing process was done iteratively through intense collaborative sessions, as well as individually by one of the researchers whom was main responsible for the analysis. The discussions and analytical work from the joint sessions laid the foundation for the coding scheme. It was applied and constantly improved by the responsible coder, whom revisited and coded the rest of the material in between the collaborative sessions. A randomized sample of 10 % of the coded material was examined for intercoder reliability with the three collaborating researchers using Fleiss' kappa, $\kappa = 0.831$, which denotes an almost perfect agreement [26, p. 165]. The same sample was also examined for individual measures of intercoder reliability between each of the researchers, using Cohens' kappa, $\kappa = 0.771$, $\kappa = 0.813$, and $\kappa = 0.949$, which indicates substantial to almost perfect agreements [Ibid].

Ethical considerations

Even if all posts in the data are publicly available and associated with their dog, they can still reveal glimpses of the owners, and apparently also their dogs, private spheres. Given the nature of information in the posts, they are not likely to be considered as sensitive or directly harmful, neither for the humans or canines. Rather, they could benefit from it given the aim of this paper and ACI as a field. The humans behind the profiles are to some extent already anonymised as they are registered in their dog's name. Still, we have excluded profile names, images, and other personal information to strengthen anonymity.

When doing empirical studies in social media settings there is a trade-off between keeping data naturalistic without interference, and to reveal oneself as a researcher and ensure transparency and participation [13, p. 25]. We have not informed the participant about their participation as we have strived towards naturalistic data. Moreover, such interaction risk to influence their future social media practices and behaviors, e.g. in terms of being more restrictive and suspicious.

RESULTS AND FINDINGS

From the content analysis of social media posts by dog owners pretending to be their dogs' we identified seven facets relevant to the lifeworld's of the dogs (overview in table 1). In the following, these are presented in detail.

Physical facets

This category refers to the environment and the physical manifestation of the dogs' life-worlds, including the physical surroundings in which the dogs in the posts are situated, weather conditions, food and treats, as well as physical artifacts that appears to have a substantial role in the posts.

Physical surroundings

Information on the physical surroundings was existent in all posts. The images provided a basic understanding, such as if they were located outdoors, and additionally if the outdoor surrounding was urban (e.g. street, park, outside shopping window) or wild (e.g. up in the mountains, lake, open field, beach). Images could also reveal if the setting was indoors and in what type of room (e.g. kitchen, hall, living room, bath room) the depicted situation takes place. The captions, and also the comments, could disclose more detailed information on the place or location, e.g. name of a city, or street, part of city, park, or nature reserve, and if they were at home, in a hotel lobby or at a friend's place, which wasn't visually available in the images. It could also provide with information on the dogs' attitudes and feelings towards the physical surroundings. For example, in an image of a dog running unleashed in an open foggy field with the caption: "*Sunrise fly in's are the best. Roaming the beautiful nature adjacent to the lovely* restaurant x *in* place y, *an incredible (dog) friendly place to stay and eat…"*. It could also, as in this example above, involve recommendations to other dogs (and their owners).

Weather conditions

Both the verbal and visual data provided with information on the weather (e.g. sunny, warmth, windy, cloud, rainy, snowy). The verbal data offered additional details, e.g. temperature, and could provide with information about the weather even when it was visually unavailable (e.g. in the posts of a dog inside a café with the caption "*waiting out the rain*").

It could also include interpretations on the dogs' attitudes towards the weather. Which, for example, can be illustrated by an image of a dog standing on the hind legs with the front paws on the owner's knee with the caption "*Enjoying*

the lovely 70F weather!", or a dog lying in the shade on the grass together with a dog friend with the caption "*Trying to beat the summer heat!*". It could also access with information on the dogs imagined attitudes towards e.g. wet paws. As in the post with an image of a dog during an early morning walk with the caption: "*When you have to get to the park sooo early in the morning before other dogs show up that the sprinklers are still going and the pavement is still wet. RUDE!*".

Physical artifacts

Several artifacts were present in the images and discussed in the text, e.g. leashes, collars, toys, dog beds, clothing and accessories. Collars and leashes were present in many of the images, but these artifacts were seldom interpreted or dealt with in the verbal data. However, being "*off leash*" and "*roaming free*" was positively interpreted as an expression for freedom and joy. Different kinds of toys (e.g. frisbee, ball, cuddle toy) and dog beds were visually available in the images and considered in the text. For example, related to ownership and relations to specific toys, as in the image of a dog lying down with a cuddle toy between the front paws with the caption: "*You better not take my favorite toy*". Clothing and accessories, e.g. bow ties, where observable in a some of the images. These where foremost commented by other dog and human profiles, e.g. "*nice bow tie*", rather than by other dog profiles. Clothing also related to fashion, where different brands, fitting of dogs clothing or "*matchy outfits*", referring to either human-dog or dog-dog clothing, were common topics.

Food and treats

The visual data rarely depicted any food or treats, but it was frequently discussed in the commentary threads, especially in discussions between dog profiles. It included taste preferences (e.g. "*... Can I just have regular yellow cheese please? Partial to basic cheddar or perhaps Edam, if I'm feeling exotic*") as well as different types of controversies with their owner around food (e.g. "*I mean, you should be getting extra treats every day! C'mon humans get it together!*").

Temporal facets

Temporality (i.e. past, present and future) was only depicted in the written text. It could be retrospective reflections referring to memorable moments they had during the day or from their young puppy days and e.g. cover different types of achievements, or the first time they encountered snow. Usually with the hashtag #tbt (throwback Thursday). It could also be contemplations about the future, such as planning or longing for events (e.g. breakfast, the weekend, taking a walk, or for the rain to stop), or humoristic reflections about future careers. This category does perhaps most clearly illustrate a reflexivity and a potentially increased biographical understanding of the human users behind the dog profile.

Relational facets

This category refers to the dogs' social life. In the images this was analyzed by the visible social formations (e.g. single dog, dog-human, dog-dog). From the text, we could analyze the details of the relations (e.g. if the human was the owner, if the other dog was a sibling or a friend) and the dogs' thoughts and attitudes towards the others.

Relations to humans

Humans was seldom present in the images, but much talked about in the text. In a few posts the dog was depicted with their owner, sitting next to each other or where the dog is being held or sitting in the leap of a human. In a few other posts the feet and legs of humans was visible in the periphery. The dog was clearly the centre of the images and this included reflections about their human fellows. Even when images depicted single dogs it was commonly discussed in the text. For example, a close-up of a dog standing on the shore with his tongue out, with the caption: "*I just had SUCH a good day with my Grandad Cheese (he's called this cos he always feeds me 'too much cheese'...)*".

Captions and comments provided a rich material to inform about the details of the relations, such as what type of relations they have, their feelings and thoughts about the humans in their social life, what they are doing together. It could reveal both positive and negative aspects of the relations, including conflicts of interests and power relations, or controversies around different subjects, such as being "*too restricted with food*". In some occasions it could also reveal loneliness, e.g. that their "*dogmum*" left them home alone, or jealousy as in an image depicting another dog with the caption "*why is dad hanging out with this dood?!"*. Labeling the caretakers as mum and dad was common in the posts. It was evident that the owners consider their dogs as family members where they see themselves as the parents, and the dogs as their kids.

Dogs relation to other humans was also present in the comments by other human profiles. These comments were filled with positive emotions filled with love, affection and aesthetic admiration. The people in their public, despite if they have offline relations or not, evidently adore and show love towards the dogs.

Relations to other dogs

Most of the images depicted single dogs, but it was also common that other dogs were present. It could for example be images of dogs lying or sitting next to each other, or images capturing the dogs while playing or running together. Even when the dogs were depicted alone, other dogs were mentioned and discussed in the text. The posts revealed a lot of information about other dogs and the dogs' relation to them in terms of e.g. if they are siblings or friends and their shared experiences. As in the post of two dogs lying on the ground looking up towards humans whose legs only are visible in the image, with the caption: "*My favorite birthday photo with my brother. We are waiting patiently for a birthday steak*".

There were also discussions between dog profiles in the commentary thread. In these discussions they for example

made plans and arranged future meetings of walking together. It could also be different types of invitations, or comments supporting the utterances in the original caption. The interpretations were commonly exaggerated along discussion thread, rather than providing alternative interpretations. They also discussed different aspects of their owners, for example related to food/feeding and treats as in the comment: "*No banana?! Outrageous. If this cruelty persists come over to our place… we have bananas as well as peanut butter treats, carrots and apples and we'll share them with you ;)*".

Relations to other animals

The dogs' relations to other nonhuman animals was also identified in the material, however only to a limited extent. It included other companion species such as cats, and wild animals such as geese. The former was exemplified by a dog standing in front of a dog bed occupied by a cat with the caption: *"Um, excuse me? Isn't that my bed?"*. The latter was exemplified by a dog was standing in a mountain lake close to flock of wild geese, with the caption: *"When you're chasing geese but your humans tell you to "leave it". Okay. I guess I'll just stand here then"*. This engaged a discussion about the dogs' instinct to chase other animals, in this case geese, and the owner's commands and control of such instincts. In a sense, these conversations were more about relations and controversies between the caretaker and the dog rather than dog-other animal relations.

Situational facets

This category refers to the many situations, in terms of activities and events that the dogs were faced with in the posts. Typically, this was connected to the ordinary and mundane aspects of everyday life of canines, e.g. walking with their caretakers, playing with other dogs or humans, peeing and marking, grooming, sleeping or resting, eating or waiting for food, beach trips, bathing, hiking, being unleashed in the backyard, sports (e.g. dock diving) and specific events (e.g. birthdays).

In a few posts, the situations were unnatural and exaggeratedly staged by the humans, such as in posts of a dog in a bath tub with the caption: "*I like to unwind with a long hot bath and a glass of pinot grigio*", or an image of a dog lying on the back in an armchair with a book on his chest and a half empty glass of wine on the table with the caption: "*Because ma took too long to get ready*". These posts are examples of an extreme form of anthropomorphism with clear humoristic undertones. However, the majority of the posts in the material was about ordinary everyday situations, depicting mundane activities and human-canine interactions without such an exaggegerated perfomance.

Bodily facets

A number of physical actions was identified in both the images and the verbal interpretations. These have been categorized as bodily movements, postures and gaze. Examples of the former includes e.g. walking, running, standing still, and for latter e.g. sitting, lying, carried by human. In the images these where usually easy to identify, and in the captions, these could be exaggerated as when a jumping dog is referred to as flying or when a posture is interpreted as posing. Exaggerations tended to increase in the commentary thread and confirm the original caption and could end up in a dog having their own airline or being a pilot. In the images, we could also analyze the direction of the dogs' gaze and what they possible were looking at. The dogs gaze was rarely interpreted in the text only in a very few cases, but foremost the interpretations considered other aspects.

Inner facets

This category refers to the inner lives of dogs in terms of their thoughts, emotions and attitudes. It was prevalent in most of the posts and is a central feature of dog blogging.

Emotion and attitudes

The dogs' emotions and moods to are expressed in a highly anthropomorphized manner. Several types of emotions were identified in the material, both positive (e.g. happiness, joy, love, freedom), and negative (e.g. boredom, loneliness, longing, grumpiness, anger, jealousy). The former can be exemplified by the following caption to a close-up of a dog with his tongue hanging out: "*Happy face – when Mumma brings home some goodies*" and the latter by a dog with a similar facial expression standing in a bathtub filled with water covering her paws and the caption: "*I had to take a bath. I may be smiling, but it wasn't fun*". The interpretation of the mood and emotions of the dogs was either connected to the facial expressions of the dogs (as in the first example above, i.e. "happy face") or related to specific activities or events (e.g. a feeling of sadness when being ill and on medication or the joy of taking a morning walk or hiking up in the mountains). The latter could also have been something that owners have interpreted from previous bathing situations throughout the years. As such they possess some kind of kinesthetic and biographical knowledge about their dogs and what they have over time learned (or at least think they have learned) about what their dogs like and don't like to do. Attitudes towards different things in the dogs lifeworlds e.g. the physical surroundings, weather, artifacts, food, relations, was a common topic in the posts. It permeates all of the identified categories which can be seen in several excerpts in many of the other categories.

Superficial facets

This category refers to the characteristics and appearance of the dogs. It was most commonly expressed in comments on the perceived aesthetics of the dogs (e.g. "*cute*", "*adorable", "sweet"*), mostly by other human profiles, but in a few cases also by other dog profiles. It could also be other fundamental features, such as breed and typical attributes (e.g. *style of eyebrows, moustache,* or *corgi poses*). Clothing, accessories and fashion that was mentioned under the category physical artifacts is also related to the superficial facets. It was also common with comments on the photographical quality of the images and

other aspects and technicalities related to photography. This category is apparently foremost about the human perceptions of the dogs. It is uncertain to what extent this is positively meaningful for the dogs.

DISCUSSION

The study intends to increase the understanding of canine life in the area of Animal-Computer Interaction (ACI) in general, and extend its methodological toolbox. We suggest to draw on dog-owners empathic accounts of the lives of their companion dogs in social media where they pretend to be them and imagines life from their perspectives. This approach of observing people that pretend to be their pets and imagines life from their perspective is not restricted to a content analysis. It can be applied to various data collection methods, as well as on other settings than dog blogs. It complements available design methods, e.g. interviews, observations, speculative and participatory design, with the idea of "kinesthetic empathy" [48]. This methodological approach which builds on dwelling into the dogs' perspectives by people living close with their pets have its obvious limitations but opens up a different kind of knowledge, compared with e.g. interviews with dog owners about their dogs, or ethnographic observations of animals and human-animal interaction in situ.

In specific, we add to previous research on "quantified pets", by investigating which topics that could be of interest in designing such systems and how it could be measured. In the following we discuss our assumption of dog posts as expressions of kinesthetic empathy as well as the design implications of the is approach.

Kinesthetic empathy in dog blogging

There are several indications that blog posts are expressions of "kinesthetic empathy" [48]. As discussed, the concept refers to a bodily sensibility of mutually accessible experiencing between the interactants. As such it shares similarities with an ethnomethodological approach to studying the details of manifest human-animal interaction in concrete and ordinary situations (e.g. [2; 16; 27]). Kinesthetic empathy includes a biographical and historical understanding of the individual animal. This is central for the dog owners who shares the lives with their pets and have deeper knowledge and experience of their biography than for example animal experts. In that biographical sense, it is the dog owners that are the experts of their dogs.

The biographical aspect of kinesthetic empathy is evident when it comes to the caretakers' ambitions to understand and interpret the life worlds of their animals. In a sense, they are also writing their dogs biography when they are occupied with the reflexive and social practice of dog blogging. In the analysis, we identified temporality (i.e. *temporal facets*) as important, it could for example be posts where they are looking back to their years as a puppy and what they have accomplished so far. The biographical understanding also involves different types of facets in the dogs' lives, such as their social lives, what they are doing, and what they seem to like to do.

To what extent does the dog blogs express empathy with their dogs in terms of kinesthetic awareness of their bodily experience? The captions seem to a large extent be grounded, or at least they refer to, bodily aspects such as postures, movement, and facial expressions of the dogs. They are also understood in a context to, e.g. what they are doing (i.e. *situational and activity facets*), where they are (i.e. *physical facets*), whom they are with (i.e. *relational facets*). This is something that can't be revealed without that sort of biographical and contextual information. The dogs experience (i.e. *inner facets*) of all these facets in the dogs' life worlds, e.g. what they are thinking and feeling towards the specific places, things, dogs, their caretaker or other people etc. either seem to be interpreted based on bodily movement, postures and expressions with a historical awareness of previous experiences. The dog owners' understanding and empathy for their dogs is very much a combination of a bodily and biographical awareness. However, their interpretations are not to be seen as valid explanations of their dogs' subjective lifeworlds.

This kind of practice can also be understood as a practice which would increase an empathy with their dogs as they are constantly reflecting and adds to their dogs' biographies. It is also in that sense that dog blogging can be connected to quantified pets as it increases the knowledge of their own dogs and likewise about the owners themselves in their role of caretakers.

Limitations in seeing dog blogs as kinesthetic empathy

Our approach is grounded in an understanding of dog blogs as expressions of kinesthetic empathy. However, such an approach has a number of limitations that needs to be recognized.

All attempts at getting "inside the mind" of another species or observing and describing their behavior, constantly leads us, in various degrees, to subjective anthropomorphizing where the animals are portrayed with human-like qualities, or with concepts used to describe human behavior. Companion dogs, who live close upon us and that sometimes are considered as part of our families, are especially subjected to anthropomorphism.

The empirical data speaks of other concerns than canine empathy. This is most visible in the numerous jokes made on behalf of the animal. The blog posts are to a large extent permeated with joyful and humoristic anthropomorphism, noticeably in combination with a large dose of love and affection for the dogs - both by the owners pretending to their dogs and in comments and likes from other dog and human profiles. However, an attraction towards humoristic effects can lead to a bias in what facets to reveal in their dogs' lives, that fits the humoristic line. The topics and situations highlighted in the posts are selected and staged by the human caretakers and does not reveal all aspects in their dogs' lives.

Despite the caretakers' ambition of expressing their dogs' experiences, dog blogging is to a large extent

anthropocentric [30]. Obviously, an orientation to other concerns than the dog, make the material more problematic as an expression of canine user demands. It can either be either misleading and lead to design ideas that does not support quantification of positive dog experiences. In the worst case, it can lead to design that is bad for the animal, in the sense that Lawson et. al. [28, 29] has discussed. Although we surely need to better understand dogs in order to design for them, we suggest to see "kinesthetic empathy" as a complementary approach to existing methods.

Design inspiration for quantified dog applications

We argue that design that is influenced by kinesthetic emphatic accounts broaden the design space of quantified pets. In specific it opens a discussion on what, such as new variables and aspects of dog life, to "quantify" and how to do it. We will now discuss these suggestions more in detail and also reconsider how to measure these new variables for pet informatics.

First, we can use the study to discuss what is interesting to quantify beyond the "physical health paradigm". In the analysis, we identified several facets of the dogs' lives, including the pleasures of human-dog relation, dog-dog relations, food, everyday activities, seen from an imagined perspective of their dogs. It covers several aspects of the everyday lifeworld of canines where "things, activities, relations, and events have experiential significance" [9, p. 89].

Second, the study reveals a broad range of actions where technical sensors could be applied. As we discussed, the dominant form of technology in previous research is the accelerometer, which measure changes in movement along various axes. However, if we align our suggested categories (presented in table 1) with common sensor technology, a number of other sensorial dimensions are revealed. It extends the technical design materials to other types of available sensors, as described in the following:

Physical and temporal facets: A GPS would sense the whereabouts of the canine; the weather could be sensed by meteorological sensors, and artifacts could be interacted with through e.g. RFID technology. Temporality is obviously measured by a clock.

Relational and situational facets: There are a number of sensors that measure aspects of relations, such as proximity between two objects. Such sensors include GPS in combination with mobile networks, or various forms of short-range communication technologies e.g. Wi-Fi, Bluetooth or NFC. Information on activities and events could be identified and measured by analyzing combinations of different sensor data, e.g. whereabouts and movement patterns, to identify a specific activity such as dock diving or dog-dog play.

Bodily and inner facets: Present quantified pet technology, with its accelerometers, focus on physical activities such as sitting, smelling, walking etc. Sensors mentioned above, as well as tensiometers and biometrics can be used to quantify physical activity. Although mental activity and what the dog thinks, is common in the dog posts, it is beyond the scope of present technology to quantify those. Nonetheless, measuring dogs' attitudes towards e.g. activities, places, or social relations, would of course be fruitful knowledge for the dog owners.

In sum, a study of kinesthetic empathic expression broadens the scope of the "quantified pet" design agenda both when it comes to what is interesting to quantify and how to measure it. Importantly, our study does not specify the applications in detail. Rather, it suggests an interesting linkage between various sensing technologies and a broad spectrum of animal relevant "quantifiable" aspects of life. These can also be combined and correlated with each other to increase understanding of individual dogs.

The analysis reveals that the dogs' perspectives and experiences, when imagined by their owners, is concerned with mundane things like social relations with other dogs as well as humans; spatiality and the physical environment; physical objects; emotional attitudes and various set of ordinary activities. This implies that design of "quantified pets" should not be limited towards the "physical health paradigm". But rather to focus on the mundane and ordinary aspects of everyday dog life that possibly can be important and meaningful for them. There is more to dog's wellbeing than physical health, e.g. dog's social life with other dogs and humans, is also an important aspect that can be measured.

CONCLUSION

The interest in Animal-Computer Interaction (ACI), with a focus on designing for animals, is growing, although the development of methods in which to account for the users' demands is at the beginning. This situation is also reflected in the design of "quantified pets" technology. We are faced with a challenge to design for users that cannot speak with human. We have argued for an increased methodological creativity and pluralism, and a need of grounding design in detailed empirical studies of ordinary dog practices. Our suggestion is to turn towards those humans that live closely with the animals, but not just interview them. Animals' demands are not easily articulated without serious effort. A way forward is to piggy-back on those accounts in social media where the caretakers acts out as animals by interpreting the subjective lifeworlds of their dogs. By taking part of ordinary dog owners that have an intimate day-to-day relation with their dogs, and their spontaneous reflections in social media about their dogs' lives from their dogs' perspectives, we can increase our understanding of what might be important and meaningful for companion dogs as well as for their owners in ordinary dog-owner relationship. Quantified pet technologies could further increase such knowledge about individual dogs for the owners and provide means for reflection about dog's life, which in turn can re-configure their everyday lives and relationships.

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