# Exploring The Reactions Of Companion Animals As Unintended Users Of Social Robots

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*DIS '19 Companion*, June 23–28, 2019, San Diego, CA, USA
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ACM ISBN 978-1-4503-6270-2/19/06.
https://doi.org/10.1145/3301019.3323891

## Abstract
In questioning how domestic animals might react to robots designed only for human use, we conducted an informal design research exploration that observed the reaction of two cats to a small social robot placed within their home. We explored two different approaches to revealing technologies to pets: sudden exposure through placing the robot in the space, and a gradual sensory-considerate introduction. While the results remain inconclusive, the exploration helped us gain insights into Animal-Computer Interactions (ACI) in domesticated animals, and to recognize potential behavioural considerations for the design of robots to be placed in multi-species households.

## Author Keywords
Multispecies Interaction Design; Animal Robot Interaction; Post-anthropocentric Design

## Introduction
Personal assistance and social companion robots for humans such as robotic vacuum cleaners, BUDDY [1], and Nao [2] are now becoming commonplace. However, most social robots are specifically designed to interact with humans and rarely are multi-species interactions with robots considered. While commercial advertisements and DIY videos show companion animals often enjoying the company of such robots, introducing new technologies in

**Figure 1:** Choutu, is the more dominant and aggressive cat. She has been living in the apartment for over 7 years, and is very attached to her caretakers.

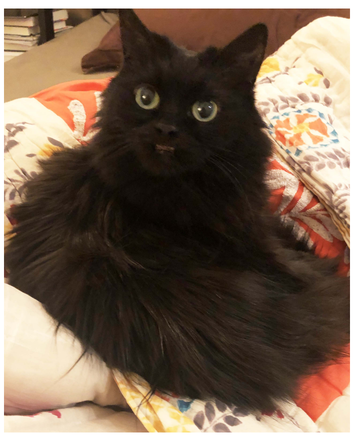

**Figure 2:** Luna, was a rescue, adopted 6 months ago. She has not yet developed as strong a bond with her caretakers.

the home can be a source of potential stress to animals. For example, altering the environmental factors in a home such as sound levels, usable floor-space, and the unpredictability of interactions can impact animal welfare [23].

Literature within animal behavioural sciences on the topic of interspecies introductions (including inter-cat, cat to dog, and cat to baby) [5, 8], has suggested animals be preemptively and gradually prepared for the newcomer [6, 4]. This approach is based on the knowledge that training enables animal learning, which informs behavioural responses [4].

Informed by the literature, in this paper, we discuss preliminary design research we conducted looking into how two cats would react to the typical method of consumers simply placing technologies inside the home and compared it to pre-planned, gradual exposure techniques.

## Related Work

Emerging from HCI, ACI studies the interactions between animals and computing technologies in order to better design interactions intended for these users [18, 17, 19]. Specific, to robotics, the majority of these interactions focus on developing robots to infiltrate animal societies [3, 7, 9, 12, 22] and utilize robots that attempt to mimic the characteristics of the species in question. Another line of research focuses on developing robots specifically to care for pets by providing a play companion [14]. For example, VARRAM robot is a commercial robot designed to encourage pets to exercise [24]. Human-animal relationships are also studied as a compare and contrast metaphor for human-robot relationships [13] particularly where the morphology or behavior of the robot is designed to imitate an equivalent animal. In one such study, dogs were allowed to interact with a hard and a fuzzy AIBO (robot dog), RC car and a real dog with the dogs preferences increasing with the realism of the interaction partner [15]. Our work is inspired by these and adds to this body of work by exploring how companion animals react to small robots introduced to homes and how might we as designers help animals to adapt to the changing home contexts.

## Design Research

Informed by the qualitative research methods discussed by ACI researchers [20, 21, 25] we adapted the method of ethnographic observation [25]. Our translation of ethnographic observation involved directly observing the two cats and collecting data via note taking and camera footage (from two cameras installed in the living room). The collected data was later qualitatively analyzed to identify feline behaviours such as social, predatory, aggression, and stressful [4, 11, 16]. The observations were made by the first author in their home that is shared with the two cats observed. The two female domesticated cats are approximately 12 years of age and in good health, with similar physiques (Figures 1, 2). The cats exhibit playful behaviour together and do not fight. The established relationship with the cats, while possibly biasing the research [25, 20], also enabled a deeper understanding of baseline behaviour profiles for the cats throughout the course of the observations. To observe how Choutu and Luna would react to Kuri, we compared two different approaches described below.

**Method 1. Direct Introduction.** In this initial approach, the cats were directly introduced to Kuri (Figure 3). The robot was placed in the living room and the caretaker explored its features using the Kuri app. This replicated the typical experience of animals exposed

**Figure 3:** Kuri is a small social robot. It's interaction involves autonomous or app controlled movement, expressive eyes, babbling sounds, and a heart light that produces different colours.

**Figure 4:** Paper and balloon prototype constructed to resemble the Kuri robot.

to the caretakers unpacking and experimenting with new products that are brought home.

**Method 2. Gradual Sensory Exposure.** This approach was conducted 1 month after method 1, and consisted of a 2-stage graduated introduction: conducting a test introduction to the robot with a paper-prototype and finally introducing the Kuri robot.

*Paper-Prototype of Robot.* Due to the limitations in controlling the autonomous features of the Kuri robot (such as speed, movement pattern) we used a Wizard of Oz approach [10], to gradually introduce the cats to the features of Kuri (Figure 4). First, the paper prototype was placed in the home similar to a new furniture item. Over 3 days, functional features were introduced, such as adding movement by pushing paper-Kuri followed by adding sound by use of a bluetooth speaker inside paper-Kuri.

*Actual Robot.* Next, the real Kuri was gradually introduced by increasing "aliveness" where possible. The robot was initially placed within the living room, and periodically relocated, but not turned on. On the second day, the robot was turned on for autonomous movement. Finally, the audio component was gradually introduced (via increasing volume) throughout the fourth to sixth days. Throughout the process, the cats were provided with access to spaces that were off-limit to Kuri, that allowed privacy and a sense of safety for activities involving sleep, food, and litter [5, 8].

## Results

Through introducing a foreign object, a degree of unfamiliarity was imposed onto the cats. Typically, environmental changes can trigger two distinct negative emotions experienced by cats – the fear-anxiety system (the need for self-protection through avoidance) and the frustration system (seeking to regain control of the environment through aggression) [11].

The response to Method 1 resulted in both cats immediately fleeing the living room and avoiding the space for the first day. On returning, they would spend short amounts of time in the space, move slowly and cautiously, while the robot was active. Feline behaviour literature suggests this is indicative of feeling confronted and threatened [4].

In contrast, the initial responses to the paper prototype resembled curiosity and only lasted for a few minutes (Figure 5). Similarly, when the robot was initially turned on, the cats did not flee and watched from a safe distance as the robot moved autonomously throughout the room. There were instances as early as the second day, where the cats would approach and sit approximately 3 to 4 feet from the robot. However, despite this observation, we noticed that on the third day the fear they might have experienced was redirected as aggression towards one another [11, 16]. While instances of hissing and growling occurred between the two cats when the robot was active, intercat aggression was observed to be occurring more frequently in the first method and never occurred with the paper-Kuri. Additionally, a new behaviour emerged of jumping on furniture items within the shared space as a means of travel, and possibly to avoid the robot.

In terms of directed attention and acceptance, the cats acclimated fastest towards the paper prototype. Within the first 30-minutes of introducing the paper robot, the cats became fairly indifferent towards the prototype, giving it the same amount of attention as other furniture items in the same room. In contrast, both cats' attention were always drawn to the autonomous Kuri whenever they were in the same space. For instance, their gaze would

**Figure 5:** Luna curiously approaching and sniffing the paper-prototype.

**Figure 6:** Choutu observes Kuri as it moves throughout the space.

immediately be directed towards the robot when entering the room, along with periodically glancing at it after settling down in the shared space. Due to this, we believe that the cats never fully adapted to the robot as they were concerned and wary in its presence [4].

Finally, after Kuri’s removal, the cats progressively returned to normal behaviour over three days, as indicated by: Luna resuming to spend typical amounts of time in the living room; playful behaviour by both catsin the space; and lastly, the cats resuming a friendly demeanor to one another.

Through gradually introducing Kuri, instead of immediately turning it on, the cats initial reactions were not of extreme fear. For instance, they did not flee from the room, and more quickly progressed to spending time in close proximity with the robot. Despite the planned introduction, caution continued to exist, and was never fully overcome. We believe this was due to both the autonomous nature of the robot, and the fact that method 2 could have lasted for a longer duration of time. It is not entirely clear how long method 2 should have lasted, as literature on feline introductions indicates that the pace of learning varies between individuals [4].

## Reflection and Conclusion

The current design of domestic robots typically precludes considering the impact of the robot on the non-human inhabitants of a domestic space. If not addressed, this can contribute to deteriorating the animals well being. Our preliminary findings highlight three design principles for the design of Kuri-like robots to improve their acceptance within homes.

First, in designing for multispecies homes, consideration must be given to the range of sensory perceptions and different experiences of stimuli that non-humans might have. For instance, the range of hearing for cats extends both much higher and lower in frequencies that that of humans [4]. In our exploration, there might have been unintended mechanical sounds that the cats were detecting.

Second, while some behavioural features are intended for human acceptance and enjoyment, the same behaviours might imply a different context for animals. Therefore, the design of robots should include responsive behaviours that are species-appropriate. This may even include synchronizing the social robots biorhythms and moods with that of the animals, such as turning off when they are sleeping.

Another consideration is to develop features that can provide caretakers the ability to gradually introduce robots to their pets while monitoring their changing behaviours.

The results of our exploration require further evidence in distinguishing the merits of one method over another. This difficulty is a common theme in ACI due to the communication barrier imposed with non-human participants. Aside from observation, measuring bio-data through a wearable my contribute to more conclusive data [20, 25]. We believe that based on existing human-cat introduction practices, such techniques could still prove useful.

## Acknowledgements

We kindly acknowledge the Natural Sciences and Engineering Research Council (NSERC) for providing funding to support this research.

## References


[1] Buddy robot. https://buddytherobot.com/en/buddy-the-emotional-robot/.

[2] Nao robot. https://www.softbankrobotics.com/emea/en/nao.

[3] Asadpour, M., Tâche, F., Caprari, G., Karlen, W., and Siegwart, R. Robot-animal interaction: Perception and behavior of insbot. *International Journal of Advanced Robotic Systems 3*, 2 (2006), 16.

[4] Atkinson, T. *Practical feline behaviour: Understanding cat behaviour and improving welfare*. CABI, 2018.

[5] Bergman, L. Bringing home baby: introducing a pet to your new arrival. *Veterinary Medicine* (2006).

[6] Bergman, L., and Gaskins, L. Expanding families: preparing for and introducing dogs and cats to infants, children, and new pets. *Veterinary Clinics of North America: Small Animal Practice 38*, 5 (2008), 1043–1063.

[7] Bohlen, M. A robot in a cage-exploring interactions between animals and robots. In *Computational Intelligence in Robotics and Automation, 1999. CIRA'99. Proceedings. 1999 IEEE International Symposium on*, IEEE (1999), 214–219.

[8] Bollen, K. When cat meets dog. (case notes). *Animals* (2003).

[9] Butail, S., Abaid, N., Macrì, S., and Porfiri, M. Fish–robot interactions: robot fish in animal behavioral studies. In *Robot fish*. Springer, 2015, 359–377.

[10] Dahlbäck, N., Jönsson, A., and Ahrenberg, L. Wizard of oz studieswhy and how. *Knowledge-based systems 6*, 4 (1993), 258–266.

[11] Ellis, S. L. Recognising and assessing feline emotions during the consultation: History, body language and behaviour. *Journal of feline medicine and surgery 20*, 5 (2018), 445–456.

[12] Jolly, L., Pittet, F., Caudal, J.-P., Mouret, J.-B., Houdelier, C., Lumineau, S., and De Margerie, E. Animal-to-robot social attachment: initial requisites in a gallinaceous bird. *Bioinspiration & biomimetics 11*, 1 (2016), 016007.

[13] Kerepesi, A., Kubinyi, E., Jonsson, G., Magnusson, M., and Miklosi, A. Behavioural comparison of human–animal (dog) and human–robot (aibo) interactions. *Behavioural processes 73*, 1 (2006), 92–99.

[14] Kim, J.-H., Choi, S.-H., Kim, D., Kim, J., and Cho, M. Animal-robot interaction for pet caring. In *Computational Intelligence in Robotics and Automation (CIRA), 2009 IEEE International Symposium on*, IEEE (2009), 159–164.

[15] Kubinyi, E., Miklósi, Á., Kaplan, F., Gácsi, M., Topál, J., and Csányi, V. Social behaviour of dogs encountering aibo, an animal-like robot in a neutral and in a feeding situation. *Behavioural processes 65*, 3 (2004), 231–239.

[16] Levine, E., Perry, P., Scarlett, J., and Houpt, K. Intercat aggression in households following the introduction of a new cat. *Applied Animal Behaviour Science 90*, 3-4 (2005), 325–336.

[17] Mancini, C. Animal-computer interaction (aci): a manifesto. *interactions 18*, 4 (2011), 69–73.

[18] Mancini, C. Animal-computer interaction (aci): changing perspective on hci, participation and sustainability. In *CHI'13 Extended Abstracts on Human Factors in Computing Systems*, ACM (2013), 2227–2236.

[19] Mancini, C. Towards an animal-centred ethics for animal–computer interaction. *International Journal of Human-Computer Studies 98* (2017), 221–233.

[20] Mancini, C., Juhlin, O., Cheock, A. D., van der Linden, J., and Lawson, S. Animal-computer interaction (aci): pushing boundaries beyond'human'. In *Proceedings of the 8th Nordic Conference on Human-Computer Interaction: Fun, Fast, Foundational*, ACM (2014), 833–836.

[21] North, S., and Mancini, C. Frameworks for aci: Animals as stakeholders in the design process. *Interactions* (2016).

[22] Shi, Q., Ishii, H., Kinoshita, S., Konno, S., Takanishi, A., Okabayashi, S., Iida, N., and Kimura, H. A rat-like robot for interacting with real rats. *Robotica 31*, 8 (2013), 1337–1350.

[23] Stella, J. L., and Croney, C. C. Environmental aspects of domestic cat care and management: implications for cat welfare. *The Scientific World Journal 2016* (2016).

[24] VARRAM. A Smart Robot for Your Pet, 2018.

[25] Zamansky, A., Roshier, A., Mancini, C., Collins, E. C., Hall, C., Grillaert, K., Morrison, A., North, S., and Wirman, H. A report on the first international workshop on research methods in animal-computer interaction. In *Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems*, ACM (2017), 806–815.