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# Exploring Behaviours Perceived as Important to the Human-Dog Bond and their Translation to a Robotic Platform

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**Abstract**— To facilitate long-term engagement with social robots, robots can be modelled on ‘successful’ social animals – specifically, pet dogs. Unfortunately, scientific understanding is limited to qualities of dogs that are ‘liked’, opposed to behaviours that facilitate and maintain the human-dog bond. To better understand dog behaviours that are important for building bonds between owner and pet, we collected open-ended responses from dog owners (n=153). Thematic analysis identified 7 behaviour categories: the importance of 1) attunement, 2) communication, 3) consistency and predictability, 4) physical affection, 5) positivity and enthusiasm, 6) proximity, and 7) shared activities. We consider the feasibility of translating dog behaviours into a robotic platform, and potential barriers moving forward. In addition to providing insight into important behaviours for human-dog bonding, this work provides a springboard for those hoping to implement dog behaviours into animal-like agents, avatars, and robots.

**Keywords**—dog behaviour, social robots, biomimetics, human-animal interaction, HRI, HAI

## I. INTRODUCTION

Loneliness (defined as the subjective feeling that one lacks social support or companionship) is a public health issue growing in importance and urgency due to population ageing<sup>[1]</sup>, social media influences, and most recently, pandemic-induced social isolation measures. In an attempt to reduce loneliness and its many associated consequences (e.g., cardiovascular disease, depression, and suicidal thoughts) a range of technological solutions are being developed<sup>[1, 2]</sup>. It has been proposed that the ability of social robots to analyse and respond to aspects of human behaviour make them a candidate solution for addressing loneliness in some contexts<sup>[3]</sup>. To sidestep the complexities, expense, and high expectations associated with developing humanoid robots to take on these roles, robot developers are increasingly drawing inspiration from other ‘successful’ social animals<sup>[3,4]</sup>.

In western cultures, pet dogs can provide a source of comfort and companionship, and ownership can benefit a person’s mental health and wellbeing<sup>[5]</sup>. As a result, studying human-dog attachment, and implementing dog behaviours into robots, might help us create artificial systems that provide similar benefits<sup>[6]</sup>. It has further been suggested that by creating systems that resemble dogs, we could encourage greater acceptance of social robots - allowing users to reap the benefits of dog-ownership long-term<sup>[4, 7]</sup> while minimising the costs and risks of looking after living animals.

Several studies have examined pet dog behaviours and their applicability to social robots<sup>[4-7]</sup>, with a focus on qualities and behaviours which are ‘liked’ (e.g., smartness, friendliness, attentiveness). We argue that liked behaviours could be different to those which are important to bonding –

such as how we might like, but not have a strong bond with, a household appliance. To gain clarity regarding this distinction, and to ensure future developments are grounded in a rich and informative evidence base, we asked dog owners which behaviours they perceived to be important to the bond they share with their dog.

## METHOD

### *Participants*

In total, 283 individuals accessed the online study. After the removal of incomplete datasets and incorrect responses (n=130), 153 complete datasets remained. All participants were dog owners over the age of 18 years, and the majority identified as female (female: n= 123, male: n=4, non-binary: n=1). All study procedures were approved by the University of Glasgow College of Science & Engineering Ethics Committee (#300190287). Study procedure and sample size estimation (n=128) were pre-registered on the Open Science Framework: <https://bit.ly/3dhdH9h>. All data were anonymised and will be stored for 10 years, and then deleted.

### *Procedure*

On the online survey platform ([www.qualtrics.com](http://www.qualtrics.com)) participants read an information sheet, provided virtual informed consent, and were given the option to provide an email address (entering them into a prize draw to win one of five £25 gift cards). Finally, after completing a series of questionnaires (out of the scope of this report), participants were asked to describe behaviours of their dog, according to the following instruction: “Please describe things that your dog does that you really like. Specifically, behaviours that you think are crucial to the bond you have with your dog.”

### *Qualitative Data Analysis*

Data were analysed using Thematic Analysis using NVivo software (v.12), following a rigorous six-step method<sup>[8]</sup>. This is a widely used inductive method of qualitative analysis that involves familiarisation with the data, followed by classification of recurring ideas into codes. These codes are grouped into broader themes, which are then discussed by independent coders. In this study, two coders (one analysing the full dataset, and the other analysing a randomly selected subset [20%, n=31]) agreed on 7 data-driven themes.

## II. RESULTS

The coders agreed on 7 key themes: the importance of 1) attunement, 2) communication (verbal and non-verbal), 3)

consistency & predictability, 4) physical affection, 5) positivity & enthusiasm, 6) proximity, & 7) shared activities.

#### 1. Attunement

Numerous owners mentioned how their dogs alter their behaviour in response to the owner's routine (n=17) or emotional state (n=37). E.g., the dog will display physical affection just prior to the owner waking or will provide physical affection when the owner is experiencing a low mood, appearing to pick up on their emotional cues.

#### 2. Communication

Many owners (n=88) mentioned the importance of their dog expressing their needs to them. Accounts included examples of vocal behaviour and body language (e.g., through eye contact, by presenting toys, or through the use of nudging body parts or vocalisations). Additionally, owners stressed the importance of their dog consistently listening and responding to their voice commands or gestures.

#### 3. Consistency and Predictability

The importance of consistency was a common report (n=68), specifically in terms of enthusiasm, positivity, obedience, and emotional awareness (e.g., consistently expressing joy on their owners return). Inconsistency was also reported as being desirable (n=20) – e.g., variability in play behaviour, and the dog expressing independence.

#### 4. Physical Touch

Many owners (n=86) mentioned the importance of physical touch initiated by the dog – e.g., the dog resting a body part (e.g., head, paw, whole body) on the owner, or giving the owner “kisses”, “hugs”, and “cuddles”.

#### 5. Positivity and Enthusiasm

Many owners (n=51) mentioned that when they arrive home, their dog approaches them at the door and expresses one (or a combination) of the following: erratic tail wagging, wiggling of their body, leaping into their arms, jumping up and around excitedly, or bringing a toy.

#### 6. Proximity

Owners (n=18) mentioned the importance of their dog physically following them (e.g., from room to room), physically touching the owner whilst co-sleeping (n=48), and generally remaining in close proximity while at home or out on walks (n=18). The owners perceive this behaviour as resulting from love, loyalty, or the owner being a perceived source of nurturance or protection.

#### 7. Shared Activities

Many owners (n=100) mentioned playing (e.g., games, training, general playful behaviours) and how the dog's perceived enjoyment of activities was important for bonding. People also mentioned the importance of affection and ‘checking in’ behaviours whilst walking together (n=43).

### III. DISCUSSION

By using open-ended questions, we gathered rich detail about specific behaviours (7 core themes) perceived as important for the human-dog bond. While many of the behaviours could be implemented in a robot, significant gaps in our knowledge remain, which will result in barriers to implementation.

Further exploration of these behaviours would be an important next step. For example, many participants expressed that “cuddling” is important, but they did not specify what “cuddling” consists of. To translate such behaviours into a robotic platform, we will need a fuller understanding of the individual components of the dog behaviour. Our online study design prevented us from asking follow-up questions, but future research can build on these findings.

Future work could use video and motion capture technology to further classify dog behaviours and owner reactions. Incorporating rigorous qualitative methods could also facilitate insights regarding anthropomorphic attributions, and the role that individual preferences play. By conducting controlled mixed-methods experiments with robotic dogs, it should also be possible to manipulate the presentation of dog behaviours and determine desirable behavioural boundaries – e.g., in terms of intensity, frequency, or duration of behaviour.

Conducting further research, to better understand how preferred dog behaviours can (or cannot) be successful modelled onto dog-like robotic systems, stands to greatly inform our understanding of the costs and benefits of dog-like social robots in psychosocial interventions.

### IV. CONCLUSION

This study provides detailed insights into dog behaviours perceived as important for maintenance of the human-dog bond. We recommend that next steps focus on exploring the nuances of these behaviours, and testing the applicability and feasibility of programming such behaviours into dog-like robots. Exploring users' reactions and engagement via quantitative and qualitative methods will be important evaluation strategies.

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