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Should we love robots? – The most liked qualities of companion dogs and how they can be implemented in social robots

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ABSTRACT

In the future, robots may live with users as long-term companions, thus it is important that some sort of attachment relationship develop between humans and agents. Man's best friend the dog provides a model for investigating what makes a heterospecific companion a lovable social partner.

Thus, we studied people's attitudes toward dogs and robots comparatively, with a special focus on those features in dogs that cause people to accept them in their homes and love them. Additionally, we explored from what kind of behaviors people infer these qualities.

We found that people's attitude toward robots is much more negative than towards dogs. Having emotions, personality and showing attachment were the most frequently reported advantages of dogs. Respondents showed high agreement about the behavioral manifestation of these qualities, which are necessary for engineers to be able to implement such advantages into the social robots' programs.

Based on our results, in the future roboticists may supply social robots with these preferred qualities, which will aid in the designing of successful social robots.

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1. Introduction

Many of the present-day social robots are designed according to human behavior (e.g., they mimic human facial expressions, and use language, etc.). Although in many contexts humanoid robots have advantages, there are still major limitations regarding their capabilities, which reduce their lifelikeness or may trigger Mori (1970) uncanny valley effect (e.g. Saygin, Chaminade, Ishiguro, Driver, & Frith, 2012; Yamaoka, Kanda, Ishiguro, & Hagita, 2007). Humanoid appearance has been shown to be undesirable to most people (Arras & Cerqui, 2005, pp. 1–41). Additionally, considering that people expect that the behavior of the robot should match its appearance (Goetz, Kiesler, & Powers, 2003; Nomura, Kanda, Suzuki, & Kato, 2008), humanoid appearance triggers huge challenges for the development of the human-like behavior of the robot. From a functional approach, most social robots do not need to be human-like to fit their original role (e.g. assistant robot for the elderly: Pineau, Montemerlo, Pollack, Roy, & Thrun, 2003); or for

office purposes: Severinson-Eklundh, Green, & Hüttenrauch, 2003). Thus, more efforts should be made to develop non-human-like robots focusing on their specific function with regard to both their appearance and behavior.

For the believability of artificial agents with social functions, it is often important for the user to be able to attribute emotions and personality to the robot, and to achieve successful communication with it (e.g. Fong, Nourbakhsh, & Dautenhahn, 2003; Hudlicka, 2003; Padgham & Taylor, 1997; Bates, 1994). Considerable evidence supports that humans attribute emotions and personality not only to other people, but also to non-human animal species (e.g. Gosling, Kwan, & John, 2003; Morris, Doe, & Godsell, 2008), and they can achieve successful cooperative interactions and communication with them (e.g. with dogs and cats: Miklósi, Pongrácz, Lakatos, Topál, & Csányi, 2005; elephants: Smet & Byrne, 2013; ferrets: Hernádi, Kis, Turcsán, & Topál, 2012; etc.). Thus, human-animal interactions can be used as inspirations for building behavior models for social robots that have much less communicational capabilities than humans. Human-robot interaction has been suggested to be regarded as a specific form of inter-species social interactions (Miklósi & Gácsi, 2012). Animal behavior (e.g.

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communication) has the advantage of being much simpler than human behavior, so it is easier to implement in social robots. Hence, a plausible alternative beside human-like robots can be to develop robots whose behavior is designed based on non-human animals' behavior (Korondi, Korcsok, Kovács, & Niitsuma, 2015). Pets seem to be the best candidates for providing a model for designing robot behavior because they are able to develop effective social interactions with humans (Miklósi & Gácsi, 2012). People usually form long-term and individualized relationships with their pets, which is in many cases also included in the aims in the designing of social robots (e.g. assistant robots).

Human-dog interaction has already been suggested as a framework to model human-robot interactions (Dautenhahn, 2004; Korondi et al., 2015; Miklósi & Gácsi, 2012). Dogs have superior social skills among domestic animals (Topál et al., 2009). During the domestication process, dogs successfully adapted to the human social environment (e.g. Kubinyi, Virányi, & Miklósi, 2007) and developed a wide range of inter-specific communication skills with humans (Topál et al., 2009). Despite their less complex cognitive capacities, dogs successfully engage in complex social interactions with humans (e.g. cooperation). This social understanding is mainly based on the dog's ability to develop an individual attachment relationship with humans (Topál, Miklósi, Csányi, & Dóka, 1998). Furthermore, dogs' social behavior is very well-documented, including catalogued descriptions of their behavior elements (Fox, 1978; McGreevy, Starling, Branson, Cobb, & Calnon, 2012; Scott & Fuller, 1965). We also know that humans can successfully recognize the emotional expressions of dogs (Bloom & Friedman, 2013; Pongrácz, Molnár, & Miklósi, 2006, 2005; Walker et al., 2010), and attribute them personality (Gosling et al., 2003; Turcsán, Range, Virányi, Miklósi, & Kubinyi, 2012).

One of the most important aspects of why dogs can be good models for designing social robots is that owners love them, that is, they form a strong, long-lasting emotional bond with their dogs (Archer & Ireland, 2011). Dogs are the most popular pets (e.g. American Pet Products Association, 2011¹), and owners usually regard their dogs as a family member (Kubinyi, Turcsán, & Miklósi, 2009), or even as a child (Berryman, Howells, & Lloyd-Evans, 1985). In the future, robots may also live with people as life-long companions; hence, it is important for the users to accept not only the presence of the robot, but also to consider it as a social partner and attach to it (Birnbbaum et al., 2016; Herath et al., 2013). However, people's attitudes toward robots are rather mixed (e.g. MacDorman, Vasudevan, & Ho, 2009; Nomura, Kanda, Suzuki, & Kato, 2004; Ray, Mondada, & Siegwart, 2008), and depend largely on culture, gender and other factors (e.g. Bartneck, Nomura, Kanda, Suzuki, & Kato, 2005; Lakatos et al., 2014; MacDorman et al., 2009; Nomura et al., 2004). Attitudes toward the social or companion roles of robots are rather negative: people do not want a robot to be a friend or a mate (Dautenhahn et al., 2005), and prefer robots to do household tasks instead of social ones (Ray et al., 2008). As people's attitudes and emotions toward robots can have a great influence on human-robot interactions (Nomura et al., 2008), it is important to improve these attitudes. An analysis of what people find admirable in their life-long pet companions (e.g. dogs), and a comparative analysis of people's attitudes toward pets and robots can help to design the behavior of robotic companions. However, there is no data on what exact types of behavior people like in dogs (or other pets). If we want to develop "lovable" robots designed according to

dogs' behavior, it is important to know which features of dogs make them so lovable for people and from what behaviors of the dogs people infer these qualities.

The aims of the three studies presented were to collect information on humans' attitudes toward dogs and robots, in parallel, and to investigate what are the most liked qualities of dogs (Study 1 & 2). Additionally, we aimed to collect data on how these qualities were perceived by owners on the behavioral level (Study 3), in order to help roboticists to design the behavior of robotic partners, that is, to develop somewhat "lovable" robots.

We use the terms 'attachment' and 'love' for the same phenomenon although we do not think they are synonyms. Attachment is a well-defined scientific concept as it can be operationalized by behavioral and physiological measures (Bowlby, 1969). Love is rather a "hypothetical and multi-dimensional construct with many interpretations and implications" (Esch & Stefano, 2005). However, as we were interested in people's experience, we used the term 'love' in the studies, as it may be more comprehensible for people. 'Love' may be the experiential component of attachment, and it can be conceptualized scientifically as an attachment process (Hazan & Shaver, 1987).

Additionally, we used the term 'attitude' as an umbrella term to cover the respondents' cognitive, emotional and behavioral attitudes toward dogs and robots.

2. Study 1: basic attitudes toward robots and dogs

There are only a limited number of comparative studies on people's attitudes toward pets (namely dogs) and robots. Some of them were carried out to compare people's attitude and/or behavior towards the dog-like robot, AIBO and real dogs. People described their relationship with AIBO similarly to a relationship with a dog puppy (Kahn, Friedman, Pérez-Granados, & Freier, 2006), and they attributed animal characteristics to the robot and viewed it as a family member (Kahn, Freier, Friedman, Severson, & Feldman, 2004; Melson et al., 2005). However, when analyzing their behavior, results showed that they behaved somewhat differently toward the AIBO and a living dog puppy (Kerepesi, Kubinyi, Jonsson, Magnusson, & Miklósi, 2006; Kubinyi et al., 2004; Turner, Ribi, & Yokoyama, 2004), and they treat AIBO as a technological artifact that nevertheless embodied attributes of living animals (Melson, Kahn, Beck, & Friedman, 2009).

Gácsi, Szakadát, and Miklósi (2013) compared assistant dog owners' attitudes toward an assistant dog and an imaginary assistant robot and found that although owners could imagine future robots to possess the technical competence required for assistance, they could not imagine them as emotional companions. Perhaps because of this, they could not imagine to have an assistant robot instead of a service dog.

However, all of these studies investigated comparatively people's attitudes toward a special group (assistance dogs/robots) or type of robot (AIBO), and none have so far compared robots to dogs in general.

2.1. Aims and hypotheses

The aim of the current study was the parallel investigation of people's attitudes toward robots and dogs. We wished to explore what people like in dogs, in order to give suggestions to roboticists to implement these features in companion robots.

We were interested in what kind of expectations, preferences and attitudes university students have regarding robots and companion robots. In addition, we aimed to investigate their attitudes toward dogs and the specific characteristics of dogs, which make

¹ American Pet Products Association. "Pet Industry Market Size & Ownership Statistics" http://www.americanpetproducts.org/press_industrytrends.asp, retrieved March 2017.

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