Improving the modeling of dog-owner interactions for the design of social robots

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The paper presents an ethological perspective on designing robot behaviors for successful social interactions with humans. In particular, the types of behaviors that occur in interactions between dogs and their owners are analyzed to provide insights into how robot behaviors should be created.

For the presented study, it is impressive that the authors have gathered input from a significant number (29) of owner-dog pairs. As indicated in the article, ethology has provided a wealth of inspiration for the development of robotic systems. Regarding the study of dog-owner behaviors, it would be essential to consider the robotic application domains where such behaviors would be best suited and helpful. Robots can interact with people in multiple roles, among which being service robots, tutors, peer collaborators, healthcare assistants, toys, artificial pets, or companions for the elderly (Fong et al. 2003). It is important to note that depending on the type of target application, dog-like behaviors may or may not be best suited for robot-human interaction. A robot designed to serve as a companion, a toy or an artificial pet would most certainly benefit from being equipped with behaviors similar to a very familiar animal such as a dog. Conversely, a factory floor robot, whose main role is to work jointly in collaboration with a human, in shared spaces, on tightly coupled tasks, would require a significantly different set of interaction behaviors. In such a scenario, the robot's effectiveness in working together on a task, and its ability to establish and maintain joint attention are more critical than the robot's believability as a friendly pet. This aspect has been addressed by Huang and Thomaz (2011), who describe a conceptual model of joint attention and detail two studies that give insight into the importance of ensuring joint attention in human-robot interaction. Findings of these studies show that robots that respond to joint attention have increased task performance and are also viewed as more competent, socially interactive and are perceived as having natural behavior. In the domain of dog-owner interactions the aspect of joint attention can potentially be studied by the authors in follow up experiments that include closer interactions, such as playing a game of Frisbee, or throwing a tennis ball for example.

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The relevance to the field of human-robot interaction (HRI) of the behaviors analyzed during the study should also be considered in light of the particular set-ups chosen. The experiments, performed as a part of three tests, which included a total of nine separate episodes, are slanted toward passive behaviors from the part of the human. With the exception of the "active greeting" episode, in all the other experiments the owner is instructed not to interact with or look at the dog. As the detailed analysis presented shows, statistically significant information can be extracted about the dog's behavior under circumstances in which the owner is busy, moving, or leaving, while otherwise refraining from interacting with it. Drawing the parallel to the HRI domain, such scenarios may occur during interactions between humans and robots, for example in cases in which users are busy and do not need the assistance of the robot. However, in a possibly larger set of situations humans and robots may need to and do interact with each other in order to achieve common goals. In such cases, the behaviors inferred from the current study may not be effective or could even have detrimental effects. For example, a busy user who is swamped by his work may benefit from the help of an assistant robot, rather than having the robot explore the room or simply sit and watch the user finish the task alone. Furthermore, a robot following around a busy user, similar to the ways dogs behaved during the blocks scenario, may hamper the work of the human rather than help him and would not be regarded as natural behavior. The authors have extensive expertise in the study of dog behaviors; it would be a great extension of the current work to envision a future study that would focus on interactions between people and service dogs, such as those involved with assisting the disabled, rescue, personal protection, or sled dogs. Due to the nature of their roles, these animals engage in much richer interactions with their owners and could provide an even better basis for developing behaviors for interactive robotic systems.

A behavioral parameter that has been analyzed during the presented study relates to proximity, in particular the duration of time during which the dog is within one body length away from its owner. The results show that in most experiments (except for the ones in which the dogs' movement was otherwise restricted) the dogs sought to be in the close presence of their owners. As the authors propose, taking into account the closeness of a dog or robot to a human is essential for establishing and maintaining successful interactions. The notion of personal space was introduced by anthropologist Edward Hall in (Hall 1966), along with the concept of proxemics. His work proposes several subjective dimensions around a person, which determine the degree of comfort and types of interactions that that human can see him/herself engaging in. These dimensions go in increasingly larger sizes from intimate space, to personal, to social and ultimately to public space.

In robotics, in particular in the field of HRI, there are several studies that address the proximity of robots within a human's personal space. Takayama and Pantofaru (2009) present a study that explores what factors influence proxemics behavior around robots. The experiments take into account several situations: people approaching a robot, people being approached by an autonomous robot and people being approached by a teleoperated robot. Their findings support several important hypotheses. First, people with experience with owning pets or working with robots maintain smaller personal spaces around robots, i.e. they get or allow robots to get closer. People's traits are also a factor, in that people that are more agreeable tend to move closer to robots than people that exhibit more neurotic behaviors. This work is relevant to the study in the current article: dog owners may have different personality traits than non-owners, which could make them more agreeable to interactions with animals or other inanimate systems. Thus, the behaviors extracted from interactions with dog-owners may have to be adjusted for people with different personalities. Several other studies have analyzed how proxemics influences human-robot interactions. Walters et al. (2009) propose an empirical framework for human-robot proxemics that allows a robot to adapt its interpersonal distance to a human for better interactions. Feil-Seifer and Matarić (2010) use proxemics to evaluate interactions between children with autism and robots. Mead et al. (2013) look at individual, physical and psychophysical factors that contribute to a person's spatial behaviors and propose several models for recognizing initiation and termination of a social interaction. All these studies indicate the importance of analyzing proxemics for successful human-robot interactions. The findings of the article support many of the results obtained in these related projects. A tighter coupling between ethological and HRI studies could lead to new insights into developing behaviors for interactive robot systems.

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Biography

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