

# Acceptance and Use of a Zoomorphic Robot in a Domestic Setting

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## Abstract

The study presented in this article aims to improve our understanding of how people use zoomorphic robots in domestic environments in general and, in particular, whether people are able to build (long-term) relationships with these robots. The influences of social and hedonic factors were studied, in addition to the utilitarian factors of the Technology Acceptance Model (TAM). Three participants interacted with the Nabaztag, a zoomorphic robot, for 10 days in their own home environment. No evidence was found that hedonic factors were important for the acceptance of the Nabaztag. However, hedonic factors did seem to be important for building a relationship with the Nabaztag. Social factors did seem to be important for the acceptance of robots, but they did not seem to be important for building a relationship with the Nabaztag. Last, the results showed a relationship between naming the Nabaztag and building a relationship with it.

## 1 Introduction

Imagine the year 2019. Mr. Smith, 90 years old, is still able to live autonomously thanks to his social robot Suzy. Suzy cleans his house, washes his clothes, gets his groceries, cooks his meals everyday, does his dishes, plays card games with him, discusses politics and monitors his health. Mr. Smith states: “She is my best friend and I can not live without her any more.” Will this be reality ten years from now?

It is assumed that in the near future, social robots will be able to aid the elderly to live longer autonomously in their own homes. In the near future, robots will be able to, for example, do household tasks for them, monitor their health and be a social companion. Therefore it is important to study the acceptance and use of social robots, so that future social robots can be adapted to the wishes and demands of the elderly, which is important for the future diffusion and adoption of robotic technology.

All definitions of a social robot are built upon the same idea. That is: social robots are robots that interact via human social rules, e.g. [Looije, Chossen and Neerincx, 2006] [Leite et al., 2008] [Dautenhahn, 2002]. Social

robots appear in different forms. There are for example, humanoid, mechanoid and zoomorphic robots. Humanoid robots are social robots that resemble human beings. Second, mechanoid robots are robots that are more mechanical looking and are more often used in practical situations (e.g. to rescue people, to help them in factories). Finally, zoomorphic robots are robots that resemble animals, e.g. AIBO, Sony’s dog-like robot. In this study we specifically focus on zoomorphic robots.

### 1.1 Acceptance and Use of Social Robots

Acceptance of robots is assumed to be different from acceptance of other technical innovations. The original Technology Acceptance Model (TAM) aims to understand the utilitarian, productivity oriented, use of technology [Davis, Bagozzi, & Warshaw, 1992]. But besides utilitarian use of technology, there is also a hedonic, pleasure oriented use of technology [Heijden, 2004]. For example, on the one hand, social robots are utilitarian systems: they can do household tasks. On the other hand, social robots are hedonic systems: they offer interaction possibilities so as to be able to build long-term relationships with their users. Therefore, it is important to consider hedonic factors as well as utilitarian factors, to get a more complete overview of the important factors in the process of acceptance of social robots.

Several studies with zoomorphic robots were conducted in the last few years. However, it is striking that only a few scholars specifically focused on the acceptance of robots by users [Heerink, Kröse, Evers and Wielinga, 2006; 2008] [De Ruyter et al., 2005]. Research with the iCat showed that a more socially intelligent robot would be more likely to be accepted by users [De Ruyter et al., 2005]. [Heerink et al., 2006] found that there is an influence of perceived social abilities on acceptance of the iCat. [Looije et al., 2006] found that the socially intelligent iCat was preferred by most of the participants. [Heerink et al., 2008] also found that enjoyment influences the intention to use the iCat and this increases the likelihood that people will actually use the iCat. Playfulness is assumed to be an important factor concerning acceptance of robots as well. [Leite et al., 2008] showed

that an iCat with a more playful character helped users to have a better perception of a game played with the iCat.

Interacting with robots seems to be a social activity. When interacting with humanoid robots for the first time, people seem to approach them in groups, e.g. [Shiomi et al., 2006, p.311] "Its name-calling behaviour attracted many visitors. They tried to show the RFID tags embedded in the nameplates to the robot. Often, when one visitor did this, several other visitors began showing their nametags too, as if they were competing to have their names called." [Weiss et al., 2008] studied users' first everyday life experiences with a mechanoid robot. Their results showed that mechanoid robots were also approached in groups. Every time someone tried to interact with the robot via the touch screen, minimally 10 others became curious and started to interact with the robot as well. We are curious to find out whether zoomorphic robots are also approached in groups when first time interactions take place.

Furthermore, robots also seem to be a topic of conversation. People tend to talk about robots with each other. E.g. [Robins, Dautenhahn, Te Boekhorst and Billard, 2004] showed that a robotic doll was used by autistic children as a mediator to interact with adults around them (investigators and carers). [Fujita, 2004] also found that when AIBO was present in a group of children, there were mutual interactions among the children, involving eye contact and some conversations. Results concerning the treatment of older people with dementia also showed that interacting with a zoomorphic robot leads to more communication with others (residents and caregivers) [Shibata, Wada and Tanie, 2003; 2008; 2009] [Wada et al., 2004] [Wada et al., 2005] [Wada et al., 2006] [Wada, Shibata and Kimura, 2008] [Shibata & Wada, 2006; 2007] [Kidd, Taggart and Turkle, 2006]. We are curious to find out whether zoomorphic robots also seem to be a topic of conversation in this study.

[Serenko, Bontlis and Detlor, 2007; Serenko, 2008] showed that personal interest in technology (PIIT) is also an important factor in the acceptance process of zoomorphic robots. [Serenko et al., 2007] [Serenko, 2008] did not find a relationship between PIIT and perceived usefulness. Thus, more innovative people do not necessarily find new technologies more useful. [Serenko, 2008] did find a relationship between PIIT and perceived enjoyment, suggesting that the more interest people have in new technologies, the more enjoyment is perceived while using new technologies.

In conclusion, several factors appear to play an important role in the acceptance and usage of zoomorphic robots besides the utilitarian factors of the Technology Acceptance Model. Hedonic factors such as perceived enjoyment, perceived playfulness and personal interest in technology seem to be important factors to consider as well, when trying to understand the acceptance of social robots. Social factors such as approaching robots in groups and communicating about robots with family and friends should also be taken into account.

## 1.2 Long-term Relationships with Social Robots

Long-term relationships between humans and robots are assumed to be very important in the acceptance process of robots. A lot of studies were conducted studying long-term relationships with zoomorphic robots, such as AIBO, a robot resembling a dog, e.g. [Friedman, Kahn Jr and Hagman 2003] [Kahn Jr, Friedman and Hagman 2002] [Kahn et al., 2004] [Fujita, 2004] [Bartneck et al., 2007] [Turkle et al., 2006] [Tamura et al., 2004] [Stanton et al., 2008], Phyno, a penguin-like robot [Lee et al., 2009], and Paro, a seal robot used for animal assisted therapy with older people suffering from dementia, e.g. [Shibata et al., 2003] [Shibata et al., 2008; 2009] [Wada et al., 2004][Wada et al., 2005][Wada et al., 2006][Wada et al., 2008] [Wada & Shibata, 2006; 2007] [Kidd, et al., 2006].

[Wada et al., 2005] [Wada & Shibata, 2006] and [Kidd et al., 2006] studied the possibility of robot therapy among older people. [Wada et al., 2005, p.2788] describe the example of an older woman, who talked to Paro, after not interacting with him for a month because she was in hospital for treatment: "I was lonely Paro. I wanted to see you again." Participants in the study of [Wada & Shibata, 2006] stated that they felt better after Paro was introduced in their nursing home. They felt as if they had a new playmate and felt less lonely. These results indicate that relationships of humans with a zoomorphic robot such as Paro could be established. This was also stated by [Kidd et al., 2006, p. 3]: "Some residents expressed a special attachment to Paro. They spoke to it like it was a pet, gave it names and engaged it in (one-sided) conversations [...] These users generally began a relationship with Paro in which they saw it as dependent of them. Very often they are/were pet owners."

There seem to be two different categories of how people interact with robots: either they see robots as artificial/as a machine, or they love and nurture them and build a relationship with it, as in the examples of [Wada & Shibata, 2006] and [Kidd et al., 2006]. For example, [Turkle et al., 2006] found that an older man interacted with a robotic doll as if it were his ex-wife. Another older man saw the robotic doll as an interesting artefact and he slapped it just to see what would happen. The man who saw the robotic doll as an artefact talked about the robot when interacting with the researchers, while the man who saw the robotic doll as if it were his ex-wife talked directly to the robot itself. A girl studied by [Turkle et al., 2006, p.351], nurtured an AIBO all the time and saw AIBO as a living being "Oh that is what my dog does when he wants attention... I think it might be sleeping. Or just stretching in a different way than a normal dog would." Another example was found in the study of [Lee, Yamazaki and Helal, 2009], who studied long-term relationships with Phyno. They found that subjects interacted differently with Phyno: they interacted with it as if Phyno was either a machine or a real creature. Thus, to be able to study whether long-term relationships with zoom-

orphic robots occur, the interaction between human and robot should be taken into account.

### 1.3 Research Questions

The purpose of this study is to get more insight in how people use zoomorphic robots in their homes and whether people are able to build long-term relationships with them. Consequently, the main research questions of this study are:

“How are zoomorphic robots used by people in their domestic setting?”

“Which factors play a role in building and maintaining a long-term relationship with zoomorphic robots?”

Until now very few studies, e.g. [Wada et al., 2004] [Wada et al., 2005] [Wada et al., 2006] [Wada et al., 2008] [Kidd, et al., 2006] studied the usage of zoomorphic robots over a longer period of time. We think that a longer time period is necessary to study whether people can build long-term relationships with social robots. The participants will interact with the rabbit for ten days in three different studies. The number of participants will increase cumulatively over time, aiming to retain the participants from the previous study. Therefore there are three during the first study, six during the second study, and nine during the third study. This study is also novel in its combination of factors that are assumed to be important for the acceptance and building of relationships: besides the often studied utilitarian factors of TAM, hedonic factors, social factors and personal interest in technology will also be taken into account.

## 2 Method

The zoomorphic robot used in this study is Violet’s Nabaztag, type Nabaztag:tag: a rabbit-shaped Wi-Fi enabled ambient electronic device that can connect to the internet to process specific services via a server located at [www.nabaztag.com](http://www.nabaztag.com). The Nabaztag is able to receive predefined spoken commands, but it is not able to understand natural language. It has no mechanisms of learning or memory. Through its programmability, however, the Nabaztag can serve as a robotic user interface to intelligent applications that make use of external sensors and programs. More information about the Nabaztag can be found on the website [www.nabaztag.com](http://www.nabaztag.com).

### 2.1 Procedure

The Nabaztag was installed for 10 days in the participants’ homes. It was installed in a place where participants passed it when leaving the house. The set-up consisted of the Nabaztag, a microphone and a video camera which was installed above the Nabaztag, as can be seen in figure 1.

The participants were told that the goal of this study was to help the participants lead a healthy lifestyle. Therefore the function of the system was to ask the participant if they were sticking to an activity plan which they had devised themselves, to ask them to reflect on how they were feeling after a day which had involved some activity, and to ask them to weigh themselves to keep track of their own weight as an

indication of their long term health and fitness. The participants interacted with the Nabaztag using buttons for ‘yes’ and ‘no’. The Nabaztag could also provide participants with a weather report and could pass on messages from the researchers. The Nabaztag initiated different conversations at five different times of the day, namely (1) at the first appearance of participants in the morning, (2) when participants were going out of the house, (3) when participants were coming home (4) at a designated time after the last planned activity of the day and (5) when participants were receiving a message from the researchers. At the beginning of every interaction, the Nabaztag asked participants to press a button to give permission to be videoed at that point in time. These videos will be analyzed at a later time.



Figure 1 Set-up of the Nabaztag

### 2.2 Participants

Three respondents participated in this first study. The aim is that they will also participate in the second and third study. All participants were citizens of the United Kingdom, female and older than 50 years of age. The educational level of the participants differed: one had a bachelor’s degree, one had a master’s degree and one was in formal education until the age of 16. Two of the participants were employed, one was retired. Two of the participants lived alone, and one lived with her husband. Participants were asked about their interest in technology and all participants were fairly interested. They all belonged to the early majority in the adoption process of technologies [Rogers, 1995]. After the interviews were completed, participants received £20 as a compensation for energy costs incurred during the study.

### 2.3 Interview Scheme

After the 10 day interaction period, the participants were interviewed about their experiences with the Nabaztag. All interviews were audio-recorded with permission of the participants. The interview was semi-structured and

the primary questions were the topics addressed in Table 1. After answering the primary question, secondary questions were asked to clarify the answers or to ask questions about topics the participant did not mention.

Table 1 Used topics/categories during the interviews

Topics	Categories
General use of Nabaztag	Intention to usage (Lee, Lee and Lee, 2006) Usefulness (Lee et al. 2006) Usage (Lee et al. 2006) Expectations Health exercises Evaluation of the possibilities of the Nabaztag (usefulness of design)
Communication with the Nabaztag (information, appearance, interaction)	Perceived enjoyment (Davis, Bagozzi and Warshaw, 1992; Serenko, Bontis and Detlor, 2007; Serenko, 2008) Perceived playfulness (Kim & Moon, 2001; Ahn, Ryu and Han, 2007)
Relationship development with the Nabaztag	Trust (Rau, Li and Li, 2009) Likeability (Rau et al. 2009) Source credibility (Rau et al. 2009) Appearance (and the uncanny valley) Relationship building Novelty effect
Social factors (family/friends)	Subjective norm (Lee et al. 2006) Self-identity (Lee et al. 2006)
Personal interest in technology	Personal interest in technology (Serenko et al. 2007; Serenko, 2008)
Demographic variables	

## 2.4 Data Analysis

After the interviews, the recordings of the interviews were transcribed verbatim. After transcription, simple serial indexing was used to analyse the data. Data was categorized via the used categories and the literal transcribed answers of the participants were added to these categories [Mason, 2002].

## 3 Results

In this article we only present the findings of our first round of analysis, namely the analysis of the simple serial indexing of the data. In a later, more extended, article the results of a cross-sectional analysis and a video analysis will also be described, including the influence of PIIT.

### 3.1 Usage in Home Environments

Regarding the utilitarian factors, the participants did not find the Nabaztag a very useful device in general. One reason was that the conversations of the Nabaztag were limited to the activity plan (“it said the same things all the time”). However, participants found the Nabaztag easy to use, except for the usage of the conversation buttons. Still, all participants would like to continue using the Nabaztag in study 2 and 3.

Looking at the hedonic factors, two participants did not find it enjoyable to use the Nabaztag due to technical problems and the limited conversation abilities of the Nabaztag (e.g., that it repeated messages). The

third participant thought that it was fun to use the rabbit. None of the participants perceived playfulness when using the rabbit.

Regarding the social factors, participants did discuss the Nabaztag and tended to show (pictures of) the zoomorphic robot to family and friends. “I talked with a few people about it. Not many.” “[...] I did show one or two a photograph so that they’d know what I was talking about.”

### 3.2 Long-term Relationships

Two of the three participants did not build a relationship with the Nabaztag. They also did not give the Nabaztag a name. One participant built a relationship with the Nabaztag, giving it the name Harvey, and finding the rabbit enjoyable to use. She described the relationship between herself and the Nabaztag as: “He asked the questions, I answered them.” Although she did build a relationship with it, she did not see the Nabaztag as a friend. “No, I just got used to this, he was a presence. He’s a man-made presence or even a women-made presence, in my kitchen, who was doing a job of research. I always knew that that’s what it was.”

## 4 Discussion

The results showed that regarding the utilitarian factors, the participants did not find the Nabaztag useful. However, they found the Nabaztag easy to use, except for the buttons that were used to communicate with the Nabaztag. No evidence was found at this stage to indicate that hedonic factors, enjoyment and playfulness, were of importance for the acceptance of robots. Even though the Nabaztag was not perceived as useful and enjoyable, all participants indicated that they would like to continue to use the Nabaztag in the second and third study.

There was one indication that hedonic factors are of importance in building a relationship with the Nabaztag. The results showed a relationship between hedonic factors (in this case enjoyment) and building a relationship with the Nabaztag, since the only participant who perceived hedonic factors was able to build some kind of relationship with the social robot. More evidence is needed to confirm whether hedonic factors are of importance for the acceptance of the Nabaztag, as shown in the results of the studies of [Heerink et al. 2006; 2008] [De Ruyter et al., 2005] [Leite et al., 2008]. Therefore, these issues will be further explored in the second and third study.

Social factors did seem to be of importance for the acceptance but not for relationship building with the Nabaztag. The results showed that the Nabaztag was discussed with family and friends. This finding is consistent with the results of [Robins et al., 2004] [Shibata et al., 2003; 2008; 2009] [Wada et al., 2004] [Wada et al., 2005] [Wada et al., 2006] [Wada et al., 2008] [Wada & Shibata, 2006; 2007] and [Kidd et al., 2006]. The results also showed that participants tended to show pictures of the Nabaztag to family and friends. Showing pictures to family and friends is a finding that was not reported in

other studies. This might suggest that the participants found the Nabaztag important enough to show it to their family and friends. This could imply that they saw it as more than an article of use. Discussing or showing the Nabaztag to family and friends does not seem to be related to relationship building in this study, since all participants talked about it and showed the robot to others. This could indicate that in a later stage, after some technical improvements, all participants could build a relationship with the Nabaztag.

Another interesting finding was that there seems to be a relationship between naming the rabbit and building relationships. The results show that only one participant was able to build a relationship with the Nabaztag. This participant was also the only one who gave the Nabaztag a name. This indicates that giving the Nabaztag a name could be related to relationship building. The amount of participants who were able to build a relationship with the robot is consistent with earlier results, namely approximately one third of the participants were able to build a relationship with a robot [Kidd et al., 2006].

A limitation of this study was that the goal presented to the participants, to help the participants lead a healthy lifestyle, was not accomplished due to technological problems and the simplicity of the system. Improvement should be made for the next iterations. Another limitation was the small number of participants. But small, qualitative studies are an essential step to larger studies. Another limitation was that we could not study whether people approached the Nabaztag in groups when interacting with it for the first time due to the fact that two of the three participants lived alone.

## 5 Conclusion

This study yielded interesting insights which will be further explored in our next two studies. Our focus of attention in these studies will be (1) to establish whether hedonic factors and social factors are important in accepting zoomorphic robots, (2) to explore the relationship between hedonic social factors and relationship building with zoomorphic robots and (3) to explore the relationship between name-calling and relationship building with zoomorphic robots.

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