Acceptance and use of a social robot by elderly users in a domestic environment

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***Abstract*—The study presented in this article aims to improve our understanding of how people use zoomorphic robots in a health related setting in their 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 examined, in addition to the normally studied utilitarian factors of the Technology Acceptance Model (TAM). Three elderly participants interacted with the Nabaztag, a zoomorphic robot, for 10 days to improve their overall health condition. Hedonic factors were not found to be important for the acceptance of the Nabaztag. However, these factors seemed to be important for building a relationship with the Nabaztag. Social factors were found to be important for the acceptance of robots, but not for building a relationship with the Nabaztag. The results yielded some interesting findings that need more study: (1) the relationship between the place of the Nabaztag and acceptance and use, (2) the relationship between naming the Nabaztag and building a relationship with it and (3) the relationship between using verbal/non-verbal communication and building a relationship with it.**

Keywords-component; Zoomorphic robots, Nabaztag, acceptance and use of social robots, long-term relationships with social robots, health related settings, domestic environments

I. 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, monitors his health and plays card games with him. Mr. Smith states: *"She is my best friend and I can not live without her anymore."* 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 at their own homes. 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.

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All definitions of a social robot are built upon the same idea: social robots are robots that interact via human social rules [1-3]. Social robots appear in humanoid -, mechanoid - and zoomorphic forms. Humanoid robots are social robots that resemble human beings. Mechanoid robots are robots that are more mechanical looking and are often used in practical situations (e.g. to rescue people, to help in factories). Zoomorphic robots are robots that resemble animals, e.g. the dog-like robot of Sony, the AIBO. In this study we specifically focus on zoomorphic robots.

A. Acceptance and use of social robots

Acceptance of robots is assumed to differ from the acceptance of other technical innovations. The Technology Acceptance Model (TAM) [4] aims at understanding the utilitarian, productivity-oriented, use of technology. But in addition to the utilitarian use of technology, there is also a hedonic, pleasure-oriented use of technology [5]. On the one hand, social robots are utilitarian systems: they are able to perform household tasks for example. On the other hand, social robots are hedonic systems: they offer interaction possibilities to be able to build (long-term) relationships, e.g. friendship, with their users. Like the authors of [49] stated: "If technology adheres to human social expectations, people will find the interaction enjoyable, feeling empowered and competent." Therefore, it is important to study hedonic factors as well, to get a more complete view of which factors play an important role in the acceptance and usage of social robots besides the utilitarian, productivity-oriented which are normally studied.

Several studies with zoomorphic robots were conducted the last decade. However, it is striking that only a few scholars specifically focused on users' acceptance and usage of robots [6-10]. References [8, 9] used a cat-like robot, named the iCat. Reference [8] found some evidence that a robot that is perceived to be more social in its behaviour, will be more easily accepted by elderly users. Earlier research with the I-Cat of [11] showed that the socially intelligent condition would be more likely to be accepted by users. Reference [9] also found that enjoyment influences the intention to use the iCat and that this increases the likelihood that people will actually use the iCat. Playfulness is also assumed to be an

important factor concerning acceptance and use of robots [2, 12].

Interacting with humanoid robots seems to be a social activity. When interacting with humanoid robots for the first time, people seem to approach these robots with other people instead of individually [13, 14]. Reference [13, pp.311] found proof for this social group behaviour concerning social robots*: "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."* Reference [14] studied a mechanoid robot with some humanoid features in a city centre during shopping hours. Observed was that each time someone tried to interact with the robot via the touch screen, at least 10 other people were curious and tried to interact with the robot as well.

Furthermore, robots also seem to be a topic of conversation. People tend to talk with each other about the robots. The results of [15, pp. 280] showed that a robotic doll was used by autistic children as a mediator to interact with adults around them (investigators and carers): *"In some cases the children started to use the robot as a mediator, an object of shared attention. They opened themselves up to include the investigator in their world, actively seeking to share their experience with him as well as with their carer."* Results concerning the treatment of demented elderly people [6, 7] [16-23] showed that interacting with a zoomorphic robot leaded to an increased amount of communication with others, such as residents and caregivers. Reference [24] found that when AIBO was present in a group of children, interactions were taking place among the children, e.g. eye contact and conversations.

Last, [25, 26] showed that personal interest in technology (PIIT) is an important factor for acceptance and usage of virtual agents. References [25, 26] did not find a relationship between PIIT and perceived usefulness. Thus, more innovative people do not necessarily find new technologies more useful. But [26] did find a relationship between PITT and perceived enjoyment, suggesting that the more people are interested in new technologies, the more enjoyment they perceive 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 and perceived playfulness seem to be important factors to consider when trying to understand the usage and acceptance of social robots. Also social factors like approaching robots in groups and communicating about robots with family and friends should be taken into account. Last, personal interest in technology is also assumed to be an important factor. No studies were found that studied the same combination of factors, utilitarian-, hedonic-, social factors and personal interest in technology.

B. Long-term relationships with social robots

(Long-term) relationships between humans and robots are assumed to be very important predictors of acceptance and usage of robots. Many studies investigated long-term relationships with zoomorphic robots, like (1) AIBO, a robot resembling a dog, e.g. [27-33], (2) Phyno, a penguin-like robot [10], and (3) Paro, a seal robot used for animal assisted therapy with elderly people suffering from dementia, e.g. [6-7, 16-17]. Reference [19, pp.2788] described an example of an old woman, who talked to Paro, after not interacting with him for a month because she was in a hospital for treatment: *"I was lonely Paro. I wanted to see you again."* Participants of [22] 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. Or [7, pp. 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."* A girl studied by [31, pp.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."* The results of all of these studies indicated that relationships between humans and a zoomorphic robot could be established.

The results of [10, 31] also indicated that besides people who love and nurture zoomorphic robots and built relationships with them, there are also people who see zoomorphic robots as artificial, as a machine. Reference [31] found that an elderly man interacted with a robotic doll as if it was his ex-wife and loved and nurtured the robotic doll. Another elderly man saw the robotic doll as an interesting artefact and he slapped it just to see what would happen. The elderly man who saw the robotic doll as an artefact talked about the robot when interacting with the researchers, while the elderly man who saw the robotic doll as if it were its ex-wife talked directly to the robot itself. Another example was found in [10], where the authors studied long-term relationships with Phyno. The authors of [10] found that subjects interacted differently with Phyno: either they interacted with it as if Phyno was a machine or as if it was a real creature.

Last, [49] stated that experience with robots over time will undoubtedly shape the user's judgement, i.e., "initial impressions will change as humans gain familiarity with the robot". Therefore it is important to study usage of robots over a period of time. Until now very few studies, e.g. [6, 7] [22, 23] looked at the usage of zoomorphic robots over a longer period of time. We think that observation over a longer time period is necessary to study whether people can build (long-term) relationships with social robots.

In conclusion, people's interactions with robots should be studied long-term to establish whether (long-term) relationships with zoomorphic robots occur. Indicators for the presence of a relationship are (1) whether people love and nurture zoomorphic robots in stead of seeing it as artificial and (2) whether people talk to the robot instead of talking about the robot.

C. Research questions

The purpose of this study is to gain insight into how people use social robots, in this case zoomorphic robots, in a health related setting at home and, in particular, whether people are able to build relationships with contemporary social robots. Consequently, the main research questions of this study are:

"How are zoomorphic robots used by people in their domestic setting?" and

"Which factors play a role in building and maintaining a relationship with zoomorphic robots?"

The participants will interact with the rabbit for ten days in three different studies. The number of participants will grow during time: three during the first study, six during the second study (the three first participants and three new participants), and nine during the third study (the six participants that participated in study 1 and 2 and three new participants). The study reported here is the first study.

II. METHOD

The zoomorphic robot in this study is the 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. The Nabaztag is able to receive pre-defined spoken commands, but it is not able to understand natural language. It has no mechanisms of learning or memory. Through its ability to be programmed, the Nabaztag can serve as a robotic user interface to intelligent applications that make use of external sensors and program. More information about the Nabaztag can be found on www.nabaztag.com.

A. Procedures

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

The goal of this study was to improve the overall health condition of participants by using a zoomorphic robot that provided a personalized activity plan. Therefore, the function of the Nabaztag was to ask the participant whether they were adhering to their activity plan, to ask them to reflect on how they were feeling after a day that had involved exercises, 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 Nabaztag initiated different health related conversations at four different times of the day: (1) in the morning, (2) when participants were leaving the house, (3) when participants were returning to the house and (4) 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. Additional to the health related information, the Nabaztag could provide participants with a weather report and could also pass on messages from the researchers.

FIGURE 1. SET UP OF THE NABAZTAG

B. Participants

Three respondents participated in this first study. These participants will also cooperate in the second and third study. A brief introduction of the participants is provided below.

Participant A is female, 60 years old and has got a Master's degree. She lives alone and works as a linguist. The Nabaztag was placed in her hallway.

Participant B is female, older than 50 (she did not want to state her exact age), and has got a Bachelor degree. She used to be a biochemist and is now doing accounts. She is married and lives with her husband. The Nabaztag was placed in her hallway.

Participant C is female, 65 years old and she had formal education until the age of 16. She lives alone, is retired but leads an active life (e.g. often going to see friends, the pub, performances, concerts etcetera). The Nabaztag was placed in her kitchen near the back door because she did not have a hallway.

The participants received an incentive of £20 as a compensation for made energy costs during the study.

C. Interview scheme

After the 10 day interaction period, the participants were interviewed about their experiences with the Nabaztag. All interviews were semi-structured and audio-recorded with the participants' permission. The primary questions were the topics addressed in Table 1. After answering the primary questions, the categories of Table1. were used to ask secondary questions to clarify the answers or to ask questions about topics the participant did not mention.

TABLE I. USED TOPICS/CATEGORIES DURING THE INTERVIEWS

Topics	Categories
General use of Nabaztag	Intention to usage [35] Usefulness [35] Usage [35] Expectations Health exercises Evaluation of the possibilities of the Nabaztag (usefulness of design)
Communication with the Nabaztag	Perceived enjoyment [4] [25] [26] Perceived playfulness [36] [37]
Relationship development with the Nabaztag	Trust [38] Likeability [38] Source credibility [38] Appearance (and the uncanny valley) Relationship building Novelty effect
Social factors	Subjective norm [35] Self-identity [35]
Personal interest in technology	Personal interest in technology [25] [26]

D. Data analysis

After the interviews, the recordings of the interviews were transcribed verbatim. After transcription, simple serial indexing was used to analyse the interview data. The literally transcribed answers of the participants were added to the categories of Table 1. [39]. After the simple serial indexing, the video data was analyzed [40]. First, the videos were watched. No coding system was designed due to the explorative nature of this study. Last, we discussed the findings with each other via the visual images.

After analyzing the video data, the results of the video data were used to verify/disconfirm the results of the interviews and vice versa.

III. RESULTS

In this result section we present the findings of the analysis of the simple serial indexing of the data and the analysis of the video data.

A. Participant's health

The goal of this study was to improve the overall health condition of participants by using a zoomorphic robot that provided a personalized activity plan. However, the results showed that using the Nabaztag did not improve the participant's health. Participant A stated in the interviews that the reason that she did not exercise more was due to technological problems that occurred during the 10 day interaction period. Participants B and C stated in the interviews that their amount of exercises did not vary because they always do the same amount of exercises (they are both fairly active persons).

B. Usage in home environments

The interview data showed that participants did not find the Nabaztag a very useful device in general. A reason given in the interviews was that the conversations of the Nabaztag were limited to the activity plan (*"it said the same things all the time"*). However, the participants stated in the interviews that they did find the Nabaztag easy to use, except for the usage of the conversation buttons, the buttons that were used to talk to the Nabaztag. Still, all participants stated that they would like to continue using the Nabaztag in study 2 and 3.

The interview data revealed that Participants A and B 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). Participant C stated in the interviews that it was fun to use the rabbit. However, the video data showed that Participant C also did not seem to enjoy interactions with the Nabaztag all of the time. As the week progressed, the video's showed that Participant C became less enthusiastic. The interview- and video data also showed that none of the participants perceived playfulness when using the rabbit.

Furthermore, all participants stated in the interviews that they 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."

The video data showed that Participants A and C did not show the Nabaztag to family and friends. The video's showed that Participant C did not even show the Nabaztag when someone was around. Participant B. however, showed the Nabaztag four times to others as observed in the videos. Participant B's behaviour also was different when she was showing the Nabaztag to others compared to when she was interacting with the Nabaztag alone. The differences in behaviour of Participant B were more present at the end of the week than at the beginning of the week, and more present with friends than with Participant B's partner.

All participants stated in the interviews that they were alone when they interacted with the Nabaztag for the first time. However, the videos confirmed this finding partly. The video data showed that when Participant B interacted with the Nabaztag for the first time it was with her partner. It was not until day 6 that Participant B interacted with the Nabaztag individually for the first time.

Furthermore, the video data showed that Participant C did find a way to fool the rabbit, using her spare keys when going outside for little household tasks. Participant C also talked about this finding in the interviews. The videos also showed that at the beginning of the week Participant C also did try to fool the rabbit when pressing the no button when it asked her whether the participant had a good time doing exercises, to see how it reacted.

Another interesting result from the video data was that Participants A and C tended to talk to the Nabaztag. The videos showed that Participant A forgot to use the yes and no buttons the whole time and kept answering the Nabaztag's questions verbally. Participant C also showed this behaviour in the videos during the first interactions and, in addition, told the Nabaztag information, such as what the participant was going to do. Participant C stated during the interviews that it would

have been nice if the Nabaztag were able to answer some questions once in a while.

"It would be nice to ask the rabbit a few questions occasionally and see what happened [laughs]."

At the end of the ten day period, the videos showed that Participant C started correcting the Nabaztag when it had the activities wrong and started mimicking what it said using non-verbal behaviour. *"[..] So, every time I think, ow, I've left the washing out, I'll go and bring it in, take the thing of the hook [the keys] "Are you going out" [mimicking the rabbit] and I am thinking I am going only bring the bloody washing in. [laughs]. [..]"*

This imitating, non-verbal behaviour was also observed in the videos of participant B, who did not talk to the Nabaztag but solely used non-verbal communication when interacting with the Nabaztag. Participant B also showed the imitating behaviour: she imitated the Nabaztag during the interviews. The videos also showed that Participants B and C waved on several occasions to the Nabaztag when they were leaving the house.

Last, all participants were asked about their interest in technology and all participants were fairly interested in technology [34].

C. Long-term relationships

Participants A and B stated in the interviews that they did not build a relationship with the Nabaztag. They also stated in the interviews that they did not give the Nabaztag a name. Mentioned reasons for not naming the Nabaztag were for Participant A not seeing a reason to give the Nabaztag a name. Participant B stated in the interviews not having any emotions toward it giving it a name, but calls the Nabaztag 'rabbit' in one of the videos. Participant C stated in the interviews to have built a relationship with the Nabaztag, giving it the name, Harvey, and finding it enjoyable to use. Participant C described this relationship in the interview as: *"He asked the questions, I answered them. "*Although Participant C did build a relationship with it, the participant 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."*

Last, the videos showed that Participant C did not always enjoy using the Nabaztag. During the week, the video's showed that Participant C became less enthusiastic when using it and started correcting it when it said the wrong things.

IV. Discussion

The aim of this study was to gain insight into how people used the Nabaztag in a health related setting at home in general and, in particular, whether people were able to build (long- term) relationships with the Nabaztag.

The findings regarding the conditions of participants showed that for all participants the amount of exercises did not increase during the 10-day interaction period. As stated in the interviews, Participant A did not exercise more due to technological problems and Participants B and C did not exercise more because they were fairly active persons. This could imply that active persons do not exercise more when using zoomorphic robots. Were the participants already active? To make comparisons it is important to recruit for the second and third iteration also less active participants. Or maybe the activity plan was too limited and should be extended? These issues will be further explored in the second and third iteration.

The findings regarding usage in domestic environments showed several interesting findings.

First, the videos showed that Participant C seemed to have embedded the Nabaztag into everyday life. E.g. the video data showed that Participant C was able to combine interacting with the Nabaztag and household tasks. This could be due to the physical place where the Nabaztag was situated in Participant C's house. Participant A and B had the Nabaztag placed in their hallway, but Participant C did not have a hallway. Therefore the Nabaztag was placed in the kitchen near the backdoor. This could imply that the physical place where the Nabaztag is situated is very important for embedding it in everyday life.

Second, the videos showed that Participant C experimented with the Nabaztag by: (1) tricking the Nabaztag, enabling Participant C to go out for little tasks and not activating the Nabaztag; (2) tricking the Nabaztag when pressing the no button when it asked whether the participant had a good time doing exercises, to see how it reacted. Reference [43] found similar results when studying usage of Roomba, a vacuuming robot, in domestic environments. Participants of [43] experimented with Roomba, they used it, for example, for seeking lost little objects. Experimenting with new technology can be an indication for the appropriation of technology [44].

Third, Participant A and C interacted individually with the Nabaztag the first time. This finding differs with [13, 14] probably due to the fact that the data of the earlier mentioned studies were gathered in a public area, while the data of this study was collected in a domestic area. However, the video data showed that Participant B used the Nabaztag with someone else when interacting with it for the first time, consistent with [13, 14]. The results also showed that all 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 earlier studies before. This finding suggests that the participants did find the Nabaztag important enough to show it to their family and friends. This could imply that all participants saw the Nabaztag as more than just a functional piece of technology.

Furthermore the interview data showed that the Nabaztag was discussed with family and friends. This finding is consistent with the results of [6, 7] [15-23]. The video data showed that Participant B tended to show the Nabaztag four times to others. While showing the Nabaztag to others, Participant B's behaviour was observed to be different than when Participant B interacted alone with the Nabaztag. This could imply that Participant B found it important to show her interest in new technologie to others.

Fourth, the videos showed that Participants A and C tended to talk to the rabbit. Observed was that Participant A forgot to use the yes and no buttons the whole time, and kept answering verbally to the Nabaztag. This could mean that Participant A interacted with the Nabaztag if as it where a human being. However, the videos showed that Participant C showed the same kind of verbal behaviour, but only during the first days. Participant A only interacted with the Nabaztag for three days due to technical issues, therefore it could also be possible that Partcipant A was not used interacting with the Nabaztag yet. Furthermore, observation of the videos showed that Participant C told the Nabaztag things, such as where the participant was going or was doing. Participant C stated during the interviews that it would have been nice if he Nabaztag also could answer some questions once in a while. This could indicate that Participant C would have liked to learn more about the Nabaztag. 'Learning more about the robot' was a feature added to the studied social robot in [45-47] and the results showed that this 'self-disclosure' ability was highly appreciated by participants. 'Telling something about yourself' is also normal in human-human relationship building.

Observation of the video's showed that Participant B tended to use non-verbal behaviour when interacting with the rabbit (when interacting with it alone). This finding is consistent with the study of [41] where participants interacted with Sparky via body language and with [42] where children interacting with Keepon via mimicking its behaviour. The video's of Participant C also did show this behaviour on several occasions. For example, the video's showed that both Participants B and C tended to imitate the conversations of the Nabaztag. This quote from Participant B can provide an explanation for this imitating behaviour: *"[..] But it was always the same. [Mimicking the rabbit] "Have you weight yourself today? No? It is a good idea to weigh yourself at the same time everyday." Yes, I know.. [..]",* namely the repetitiveness of the messages of the Nabaztag, which made the usage predictable.

The videos also showed that Participants B and C waved on several occasions to the Nabaztag when they were leaving the house. We do not know what this waving behaviour means. It could just be that participants used human-human communication when interacting with the Nabaztag [48]. The common assumption is that humans prefer to interact with machines in the same way as they would interact with other humans. [49] The verbal and non-verbal communication between participants and the Nabaztag is a very interesting matter and will be further investigated in study 2 and 3.

We could not measure relationship building via the earlier mentioned criteria (talking to robots instead of about robots and behavior towards robots), because the robots were already removed from the houses of the participants. Therefore, we had to rely on observations and statements of participants about relationships. Nonetheless, some interesting findings regarding relationships were found.

The amount of participants that was able to build a relationship with the robot is consistent with earlier results, namely approximately one third of the participants was able to built a relationship with a robot [7]. First of all, the interview data showed that Participant C was able to build a relationship with the Nabaztag. The interview data showed that Participant C was also the only one who gave the Nabaztag a name. This could indicate that giving the Nabaztag a name could be related to relationship building. Naming social robots was also shown in [43].

Second, Participant C stated in the interviews to enjoy using the robot. This finding indicates that there seems to be some kind of relationship between hedonic factors (in this case enjoyment) and building a relationship with the Nabaztag, because Participant C also stated to have built a relationship with the Nabaztag. However, observation of the video data showed that Participant C did not enjoy the usage of the Nabaztag all of the time. Like stated before in the theoretical part, if technology adheres to human social expectations, people will find the interaction enjoyable, feeling empowered and competent [49]. This could mean that the Nabaztag did not adhere to the expectations of Participant C yet. This could mean that the Nabaztag needs to be further improved. More evidence is needed to confirm whether hedonic factors are important for relationship building with the Nabaztag. This relationship will be further investigated in study 2 and 3, when new features will be added to the Nabaztag.

Last, the videos showed that Participant C showed both verbal and non-verbal communication, while Participant A and B showed either verbal or non-verbal communication. This could imply that verbal and non-verbal communication are important for building relationships, because Participant C stated to have built a relationship with the Nabaztag.

V. Conclusion

This study showed that the improvement of the health conditions of the elderly participants did not substantially increase during the 10-day interaction period.

Furthermore, regarding the utilitarian factors, the participants did not find the Nabaztag useful. However, participants found the Nabaztag easy to use, except for the buttons that were used to communicate with the Nabaztag. No evidence was found that hedonic factors, enjoyment and playfulness, were important for the acceptance of robots. Although the participants did not perceive the Nabaztag as useful and enjoyable, they stated that they all would like to continue the usage of the Nabaztag in the second and third study.

We found that hedonic factors are important seem to be important for building a relationship with the Nabaztag. This topic needs more study, because the video data only partly confirmed this finding.

Social factors did seem to be of importance for the acceptance of the Nabaztag. More research is needed to find out whether social factors specifically affect relationship building.

A limitation of this study was that the goal presented to the participants, to improve the health of the participants, was not accomplished due to technological problems and a limited activity plan. Participant B and C were already fairly active, therefore in iteration 2 and 3 also less active participants

should be sought. Furthermore, the technological problems should be fixed before iteration 2 and 3. Another limitation was the small number of participants. But small, qualitative studies are an essential step to provide in-depth insight into this phenomenon. Last, we had to rely on observations and statements regarding relationships to determine whether relationships were build.

Resuming, this study yielded interesting insights that 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 whether hedonic factors and social factors are important for building a relationship with zoomorphic robots, (3) to explore the influence of the Nabaztag's physical location on its acceptance and use, (4) to explore the relationship between naming and relationship building with zoomorphic robots, (5) the usage of non-verbal and verbal communication when communicating with the Nabaztag and their effect on relationships.

Although there are still many interesting questions unanswered, this study provides a first understanding in the usage of the Nabaztag in the domestic environment and relationship building with it.

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