Doe kaa wee-naa oe-nai boo¹: Assessing children’s experiences with active and passive artificial companions

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¹ Furbish for: “I’m your friend, play with me”, first sentence of the Furby Song (Furby Manual (2005) Hasbro)

ABSTRACT
This research investigates if there is a difference, and if so, what difference there is between children’s experiences with active (Furby) and passive (plush animal - Little Donkey) artificial companions and how children place these creatures within their world.

This paper gives an introduction to the field of artificial companionship, similar studies are discussed and two case studies were conducted to come up with a research method. An experiment was conducted with 4 kindergarten classes that included observations, (group) questionnaires and a card sorting task. Results of all work is presented and discussed in the paper.

It was demonstrated that children saw Furby more as a real animal than a plush animal, but this did not make the creature more interesting on the long term. The electronic features of Furby are interesting at first encounter but wear off quickly, the expectations that the features of Furby create cannot be fulfilled, creating disappointment. In the end most children liked Little Donkey better than Furby.

Keywords
Artificial creatures, Artificial Companions, Companionship, Furby, Children, Human-robotic interaction, Artificial companionship, Social responses to technology, User conceptions, Sensitive design, Play, Passive toys, Active toys

ACM Classification Keywords

INTRODUCTION
Nowadays electronics are becoming more and more part of children’s toys. For example Elmo (Figure 1), no longer being just a stuffed animal and television (Sesame Street) character but now there is also an Elmo Live that reacts to user input. Plush animals and other toys are given the ability to make sounds, move, react to the actions of their owners and stimulate actions. These new technologies seem to enhance these toys, but is that really true? What differences would the interactivity make for play situations?

Figure 1 – Elmo Live (Fisher Price)& Furreal Friends Chimp (Hasbro)

With a passive stuffed animal, such as a Teddy bear, children can make up their own stories, create their own world, everything is possible because there are no limitations. Elmo Live however, has set responses to children’s play, possibly guiding a play situation into certain predetermined stories.

Another example is Furreal Friends: interactive animals that try to copy real human-animal interactivity on one side and baby-like behavior on the other side.

The difference between playing with a Furreal Friends monkey (Figure 1) and a stuffed monkey would be that with the interactive monkey, the responses are animal-like, predetermining that the play situation is a human-animal relation. One could imagine that the play situation with a (passive) stuffed monkey would be much more open, where the monkey doesn’t necessarily
has to play the role of an animal but can also be a baby, a friend, and does not have to have animal properties.

Following the above situation one can ask the following: What difference does it make if a toy does or does not respond to a child that is playing with it? Are children still able to make up their own stories even though there are predetermined actions or do they follow set story lines and play situation?

Just because technology makes something possible, does not necessarily mean that is has to be used or that it is a progression. More generally, one may ask: Do these new technological possibilities create an added value to toys or do they limit children’s creativity in play?

Research Goal/question
The question that this study tries to answer is ‘What differences are there between children’s experiences in play situations with active artificial companions (that react to user action, interact with the user) and passive artificial companions (that do not react to user input)?’

Questions - desired outcome
This study has to answer the following questions: Is there a difference in play, in experience? What is the difference? What research methods work best for finding an answer to these questions?

Hopefully, this research will lead to a view on which types of artificial companions are more creative or stimulate creativity in a better way.

Before doing this research, we have to find out what the history and background is of human-creature companionship, what research methods are best to use. Using the outcome of this we can come up with an experiment that will try to answer the research question.

Explanation outline paper
In this paper we will address the following; what is the history of human-animal relationships (real creatures), human-artificial creature bonding, to get a better idea of why humans are interested in artificial creatures and companions and a short overview of the field of artificial companionship is given. Following is an overview of related research and case studies and what aspects of previous experiments can be used for our final experiment. Following there will be a chapter on how the experiment will be designed followed by a chapter on how this research was conducted. This paper will end with a discussion and conclusion of our research.

(ARTIFICIAL) COMPANIONSHIP, CREATURES AND COMPANIONS
Animals have been humans’ companions for ages. Next to that, people have had various artificial creatures as companions (for example plush animals). What is the background of these relationships and how do they relate to artificial companionship?

We will first have a look at the background of human-animal companionship, following we will look into what artificial creatures and artificial companions are. Both these subjects lead to an understanding of what artificial companionship is, which is further explained in the last part of this chapter.

The history of human-animal companionship
From scary to useful to companions
Early on in history animals were only seen as scary and dangerous. About 7000yrs BC humans began to see animals as useful [2]. By spending more time working with animals, humans started to care for them and invite them into their houses. Friendships started to grow and the usefulness became less important. Since then humans and certain animals have been living together as companions.

There are many benefits to animal companionship. Pets are used in children’s psychiatric care and as companions for elderly people to prevent loneliness [4]. Research pointed out that people have less depression when they have pets. Studies showed that there are many therapeutic advantages, for example lowering blood pressure. Other studies show that pet-owners have a significantly higher survival rate after suffering from a myocardial infarction [4].

For children, the importance in having a pet is that they learn about responsibility and learn to bond with a creature outside their own family and comfort zone [2]. Another effect of bonding with a pet for children is that they learn to deal with possible death2.

Definitions
To understand what artificial companionship is, we have to understand what artificial creatures and companions are. In this subchapter we will first discuss how we can define artificial creatures and companions. After which we will have a look at what areas/fields/subjects influence/form artificial companionship.

What exactly are artificial creatures, artificial companions and artificial companionship?

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2http://www.aacap.org/cs/root/facts_for_families/pets_and_children
When we look at existing definitions of the words artificial [Table 1], creature [Table 2] and companion [Table 3], we can (choose to) say that an artificial creature is “a man-made being, but working (partly) like the real thing, animal or human-like, a being subservient to or dependent upon another creature.” And we can say that an artificial companion is: “a man-made friend, animate or inanimate, that accompanies you and that you spend time with.”

Most artificial companions are artificial creatures, not all artificial creatures are companions. Some dictionaries consider creatures non-human whereas companions can be human.

A difference between creatures and companions would be that companions are considered equals, they do not have to obey you and they are friends. Creatures can be companions and therefore equal, but can also be under control of another creature, being lower. These definitions cause a little difficulty when we look at pets, clearly humans’ companions; they do have to listen to their owners but can be considered equal.

We would consider creatures as beings that you do not necessarily have a relationship with and that can possibly be lower and that companions are equal beings that you have a relationship with.

In this paper the term artificial companion will be used for everything that is designed or created to have an emotional bond or relationship with their owner or user and the term artificial creature when it is not clear whether the being was designed to have a bond or relationship with their owner or user.

The term owner of user is not meant in a way that we are talking about store-bought objects that can be bought and therefore owned.

**Artificial creatures**

*Plush – first artificial creatures/companions*

*Real looking artificial creatures*

Plush animals are objects that can be taken everywhere and can be manipulated in all kinds of ways. Toys are a miniature version of the adult world [2] and they help children prepare for the real world and learning to deal with real life situations. Because of the inanimate character of these creatures there is room for unlimited imagination in play. Every story can be thought of and can be played with these creatures as characters. Children can create their own worlds. You could say with these toys virtual worlds existed long before digital virtual worlds came to existence. [2]

Plush animals can be considered artificial companions. They are pals, friends that you can take with you and that accompany you, but man-made making them artificial.

**Mechanical creatures**

*Real moving artificial creatures*

Animatronics can be explained as the art of creating artificial creatures and making them act like real creature and giving them controlled movement that mimics the movement of a real animal almost completely. They reinstall lost properties of real animals that plush animals lack. Animatronics make creatures look and move lifelike but won’t make the creature react lifelike. The only aim is recreating the movement and exterior of a real creature without taking interactivity into account.

Animatronics wouldn’t be considered companions; they lack the possibility to react to user input. They are made to look at, not to play with, cuddle with and have a relationship with, as one would with a real creature. They can be considered artificial creatures, they are man-made, working or acting (partly) like the real thing.

Examples of animatronics can for example be found in theme parks, like the Efteling in the Netherlands [Figures 3,4].
Interactive games/toys

Action-reaction in artificial creatures

Next we have interactivity in games and toys. For example ‘Operation’, where the main aim is interactivity focused on real (like) situations. In this game children have to perform fake surgeries. By holding tweezers they have to carefully pick up parts from a cardboard body. When the players are not careful and touch the border with their tweezers a buzzer sounds.

In this type of toys there is no aim for companionship and cuddliness or making a character look exactly like a real creature. The makers try to make the toy very interactive. A kid performs an action and the toy responds to those actions. The makers try to copy a real action in a playful way, stimulating hand-eye coordination, improving motor skills and providing entertainment.

A characteristic of these interactive toys is that it is predetermined what the play and story should be like and there’s little room for coming up with your own version or outcome.

These toys and games wouldn’t be considered companions; they are not intended to invoke an emotional feeling by the user or to create a relationship with the user. Their main focus is to play and interact, with goals ranging from teaching to entertainment.

These toys might be considered creatures; they are artificial, manmade, working (partly) like real beings and are animal or human like. You can however question if something that you can only perform actions on something but doesn’t have any other creature like aspects can be called a creature.

Artificial Companions

2.4.1 Interactive artificial companions

When we look at the previous chapter, we see that those creatures have many similarities with real animals; plush animals offer the cuddliness and can act as trustful companions, animatronics look, move and sound like real animals and interactive games and toys have similar actions and reactions. But nowhere have we seen something that can truly be compared to the companionship that real creatures offer.

There are creatures that have all the aspects of the previously mentioned artificial creatures; we can call these objects interactive artificial companions. They look, act, react, behave and sound like real creatures and are possibly able to invoke the same reactions and feelings.

There are different types of these artificial companions. There are the computer game creatures, controlled by joystick, gamepad or keyboard. Virtual worlds and interactivity are combined. Examples of these creatures are Tamagotchi, Nintendogs. These creatures can be taken care of, they invoke a sense of responsibility and you can play with them, all as if they were real pets. Next to these digital artificial companions there are tactile artificial companions. Furreal Friends for example, interactive plush animals that behave in a baby like way, that you can feed, nurture and play with. Furby’s are another example and a combination of a controllable animal (input through sensors, just as furreal friends and digital companions), electronic game and an imaginative creature.

All these companions have in common that they are meant as companions to play with, to do everyday things with, you have to feed them, make them happy when they are sad, just as you would with real pets.

Passive vs. active

Artificial companions can be either passive or active. Passive artificial companions include plush animals; people can bond with them, tell them all their secrets and stories and play with them. Active artificial companions mainly have the same properties as passive artificial companions but have an addition: they act and react to user input. This makes them more like real animals. But techniques are not so sophisticated yet that they are exactly like real animals.

Passive creatures may stimulate creativity; since there is no set game, the object doesn’t expect thing from the user. Active creatures stimulate play in certain directions; they have actions and reactions that are aimed at certain actions and reactions of users. They have many possibilities, can talk, move and react. But because of all their possibilities, users expect more than these creatures can offer and eventually get bored with them. Even a very sophisticated artificial creature like Pleo, the pet dinosaur invokes these feelings. When reading user reviews, we encountered the following: "For a tug at the heart strings Pleo does it well, until you become bored with it only to store it in the
cupboard to occasionally take it out and show to friends at dinner parties who have never seen one before.” [girlrobot] and “As much as I enjoyed Pleo I did find myself bored with after awhile. It just didn’t hold my interest enough or it did repetitive movements that I grew bored of interacting with.” [chipchick]

Artificial Companionship
We have now looked at what artificial companions are thoroughly. When there are artificial companions and there are users as their owners, there is a relation between both that we can call artificial companionship.

Artificial companionship can be described as the relationship between a human and an artificial companion.

An example of these relationships is the relationship between elderly and PARO. PARO is a pet seal that is developed as a companion for elderly [8]. Research shows that elderly can benefit from having a robotic pet as their companion. The same researchers did an experiment by placing semi-robotic babies (My Real Baby) in nursing homes and after the research was finished the nursing home even purchased more because they found out that it helped them caring for their residents. For example: when certain residents expressed extreme anxiety and were given a My Real Baby, the resident’s anxiety seems to lessen.

RESEARCH METHODS
Problem – how to assess experiences?
How can we find out if there is a difference in experience and play between passive and (re)active artificial creatures? For coming up with a design for our research we looked into related research and did two case studies.

There are a number of values that this research has to take into account. The observation has to be objective. Preferably has a way to be measured. And the actions of test persons have to be in a way that there can be something said about their experience.

Related research
When looking into other studies about artificial companions, these projects mainly involve elderly[1] and children as participants. Most of this research is on requirements for artificial companions, acception of artificial companions and influences on behavior and health. We focused on reviewing related research that has been done with children, because they are the target group in our research. In research with elderly the outcome seemed positive, the novelty value of objects should be taken into account and the studies should be (more) long-term[1].

AIBO forum
Hardware Companions? – What Online AIBO Discussion Forums Reveal about the Human-Robotic Relationship
Kahn, Friedman and Hagman researched what essences people talked about on AIBO forums Error! Reference source not found.. They did this by gathering posts from an AIBO forum. Using a coding manual (a systematic document that explicates how to interpret and characterize the qualitative data) they analyzed the data. This way the researchers could measure how the forum poster ‘saw’ their AIBO. All the posts were analyzed in five categories: Technological essences, Life-like essences, mental states, social report and moral standing. By doing this research, Kahn, Friedman and Hagman wanted to find out if people would think about their AIBO’s as if they were real animals.

This research gives a good example of using readily available data (forum posts) to answer a question. Advantages of the forum approach are that test persons are not aware that they are being ‘watched’ by researchers, they are already gathered in a group and they are given subject to talk about themselves. Gathering a large number of AIBO users in a test group would be very time consuming. The AIBO users would have to be placed in a setting and everyone would have to be interviewed, observed or the test persons have to fill in questionnaires that need to be reviewed. The results of such setups might be influenced by the test subjects knowing that they are part of an experiment.

For our research the above method could possibly offer some very good options. The limitation however is that children use internet forums and communities less frequently and in different ways than adults. We haven’t been able to find qualitative, thorough and quantitative forum sites about certain toys by children that would be suitable for this type of research. Furthermore, analyzing forum posts won’t give an insight into play situations and direct user experiences. This method could be used for researching what the difference is in the descriptive words used for passive and active companions on for example review websites.

Dog vs. AIBO – what children say
Robots as Dogs? – Children’s Interactions with the Robotic Dog AIBO and a Live Australian Shepherd
Kahn investigated in this study how children perceive and play with a real dog and an AIBO. This research was done to get an idea about how children see robotic pets. This research was done with 72 children in one hour individual sessions with either an AIBO or a real dog. During these sessions the children were asked questions in a relaxed, semi-structured interview Error! Reference source not found.. and their behavioral interactions were observed. An interviewer was present during the sessions and initiated actions with the AIBO or dog to create stimuli.

Kahn focuses in this research on four main areas of developmental psychological research that he finds to have the most to say about children’s conceptions of biological entities and their robotic counterparts Error! Reference source not found.. In the questions that were asked, the focus was on physical essences, mental states, sociality and moral standing. Kahn also observed interactions and play situations, by counting physical contact, stroking etc.

Besides the interviews and observations a card sorting task was used to find out what children’s judgments were about AIBO compared to other potentially related objects (humanoid robot, stuffed dog, desktop computer
and a real dog). This was done by having either AIBO or the dog present and then asking about a pair of cards (with pictures of the related object on it) which one was more similar.

In Kahn’s own conclusion he already mentions that it is sometimes difficult for the children to choose between two answers, for example when asking: “Is AIBO alive or not alive?”, the boy answering the questions answered he was “kind of both”. This shows that one has to come up with questions and possible answers carefully and that in this case, a child not being able to choose says something as well.

Our findings about this research are that the play sessions might have been too short for the children to get properly familiar with the AIBO. All children have a good mental image of a real dog, because it is a common and familiar thing. Therefore they would be perfectly capable of answering questions on how they see a real dog and relate it to other objects, even when they have only played with the dog for an hour. Because an AIBO is so new and unfamiliar to them, it probably takes longer to create a good mental image. It could even be possible that because an AIBO resembles a dog the children might be tempted to allocate characteristics of a dog (and the mental image that goes with it) to an AIBO. This could cause erratic results that could have been avoided by a longer play period. This way the children would have had the time to create a good mental image of the AIBO. The duration of such a period might be determined by imagining how long it normally takes children for the ‘new and exciting’ to wear of when they have a new toy. This of course depends on the toy, but we think that playing for at least 3 days and ideally a week would be a sufficient period to get familiar with the AIBO.

Next to the above I won’t have the luxury of doing individual sessions with children. I have however, more time to make the children in our research familiar with our test object (Furby).

Dog vs. AIBO – how people (re)act
Behavioral comparison of human–animal (dog) and human–robot (AIBO) interactions

This study was very similar to the previous study, both studies use an AIBO and a real dog as test objects and the format of their sessions is quite similar. The test persons, in this case both children and university students played with either an AIBO or a real dog for 5 minutes, their play session was videotaped and afterwards reviewed.

The length of the play period in this study is less important, the researchers aim was to investigate initial responses to the AIBO and real dog, no mental image of a dog or AIBO was needed to answer this question. The researchers did ask the participants if they were familiar with dogs, therefore eliminating possible hesitation towards dogs caused by unfamiliarity.

Children and Relational Artifacts - Furbies and AIBO’s
Sherry Turkle studied how children perceived ‘relational artifacts’ such as Furby’s and AIBO’s. She did this by experiments in school settings and let children take AIBO’s and Furbies home with them for week long periods [9]. Interviews were conducted and parents and children wrote down their experiences in daily journals.

This study was mainly observational and consisted of personal interviews with people that played with and cared for AIBO and My Real Baby. Because of this the outcome was very personal, the interviewer had the chance to react to the answers that people gave and go more in-depth into certain topics.

The method that was used could very well be used for our experiment. The aim of this study was to get a better understanding of the relationships between people and relational artifacts. Our research wants to investigate how children experience different artificial companions. Both studies are about experiences, emotional bonding and personal views. Subjects that can be difficult to measure but can very well be interpreted and assessed by a researcher.

Turkle’s research only involves observations and interviews and does not measure anything; because of this it might be difficult to draw hard conclusions. There were few participants and because of this you can’t be sure that the conclusions are valid in general. They do give a good expectation and presumption upon which further research can be decided.

Following this research it might be a good idea to incorporate personal observations and interviews in our research. It would be a good idea to have a larger number of participants and combine the personal, individual approach with a more measurable approach, for example one of the earlier mentioned approaches

Case studies
Because the previously mentioned related research projects do not include experiments done with Furbies, we decided to perform two additional case studies. Not by reading about research done by others but by creating play situations to see how young children react on playing with a Furby. This way we can see what issues come up that have to be taken into account when designing our experiment.

First observation/case study
The test situation was in an informal setting (family birthday party) and the subjects were three girls aged 5(Naomi), 9(Madelon), 5(Annabel). First, the 5 year old (Naomi) was approached with a Furby, she was told a little bit how to play with it.

Outcome of this observation is that children tend to expect too much out of the communication with a Furby. They got the idea of which subjects Furby responded to quite quickly but didn’t get the idea of using the exact corresponding sentence.

One important thing that happened after playing is that when an uncle made Furby commands to Naomi as a joke afterwards, she got really upset and yelled ‘don’t talk to me like I’m a Furby, I’m not a thing, I’m a real person!’(Ik ben geen ding, ik ben een echt mens!). This clearly showed she saw a big difference between herself and the Furby and definitely didn’t want to be seen and
talked to as a Furby. Interesting is that she apparently found it upsetting to be addressed as a Furby, indicating that Furby commands are not offensive when made to a Furby but are offensive when made to a human.

Also the playing together didn’t work out well, because Furby can only listen to one voice at a time, Furby didn’t understand the commands when all girls where talking at the same time. This caused some confusion with the girls and because the lack of control they became rather rough with the Furby.

What we learned from this observation/case study is that it might be hard to do a play situation where there are more children at the same time. Also the children maybe have to be instructed thoroughly on how to use the Furby.

Second observation/ case study
The second case study was with an elementary school. This test was mainly to see if our initial ideas on how our experiment had to take place were correct or if adjustments would have had to be made on our test setup.

The school was located in Vlaardingen, the Netherlands (Dagschool Erasmus). It was a public school with one kindergarten class where we were given the opportunity to ask questions in. The children were aged 4-6 years. A questionnaire was created. One researcher asked questions and made notes, a second researcher assisted with the questioning. The full interviews were recorded with a computer (audio).

For each session five children were asked to join the session. The Furby was first introduced to them, we let them play with it for a couple of minutes and then, while playing asked them questions.

After the normal questions and playing we did a card sorting task with the children where they had to say which one of two subjects (Plush animals, real animals, robot, desktop computer, Children) they liked more to play with.

The children in this test group found it difficult to understand this question. They seemed to like the Furby more because it was different and new, not because it was a nicer toy. Also, they seemed to give the same answer as one of their friends. They had to point at a card one at a time, but because of this, children started to copy each other.

It would be better to ask ‘which one is more like a Furby’ instead of asking what they liked better to play with. That way we answer more the question how they see a Furby and what they compare it with.

One other thing that came out of this case study is that the length of the sessions was too long. It took about 20 minutes on average to finish one session.

It turned out that it’s was hard to keep the children’s attention. The card sorting worked out quite well, but the normal questions were not interesting enough. Especially when the Furby was still turned on, it kept distracting the attention of the children.

Approach
Following the two case studies and related research we can decide what aspects should be present in our experiment and what factors would and wouldn’t work.

Active /passive, Little Donkey
Initially we planned to let half of the test group play with an active Furby (fully functional) and the other half with a passive Furby or a similar artificial companion (plush animal or turned off Furby).

The turned off Furby was taken out of consideration, children would probably expect technological features, since the body of a Furby feels hard and when playing they could discover the battery cover. It would be very possible that this will cause erratic results caused by children expecting feature of a electronic device and not seeing the ‘Turned off Furby as a passive artificial companion.

A Plush animal would be a much better option; in an ideal situation we would have placed an active Furby and a similar looking passive plush animal in different groups. Our options were however limited, since we had difficulties finding schools that were willing to participate in our experiment our demands could not be very high.

The school where we would perform our final experiment was involved in the Little Donkey Project, where every couple of days one child gets a donkey plush animal to sleep over, during the sleep over they write stories about Little Donkey’s adventures in its diary. This gave us an excellent opportunity to do a comparison between an active and a passive artificial companion, without having to add a new part to the participation with the school.

### Questions

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<td>What kind of something is Furby? (Wat voor iets is Furby?)</td>
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<td>What kind of beast is Furby? (Wat voor beest is Furby?)</td>
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<td>Do you rather play alone, with two or with more with Furby? (Speel je</td>
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<td>liever alleen, met twee of met meer met Furby?)</td>
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<td>Can you cuddle with Furby? (Kun je met Furby knuffelen?)</td>
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<td>Would you like cuddling with Furby? (Is Furby leuk om mee te knuffelen?)</td>
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<td>Would you take Furby to bed when you go to sleep? (Zou je Furby mee</td>
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<td>naar bed nemen als je gaat slapen?)</td>
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<tr>
<td>Do you love Furby? (Vind je Furby lief?)</td>
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<tr>
<td>Does Furby love you? (Vind Furby jou lief?)</td>
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<td>Can Furby comfort you when you are sad? (Kan Furby je troosten als je</td>
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<td>Can you comfort Furby when it is sad? (Kan je Furby troosten als je</td>
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Table 4 – Questions asked during the second observation/case study with kindergarten classes.

Interesting conclusions that came out of this case study were that the form of the questions has to be changed. The way questions were asked sometimes turned out to be too complicated (What kind of beast is Furby?) or not clear (How would you play with Furby) and therefore the questions were misinterpreted.
We reviewed this option thoroughly. And the advantage of this situation was that there already was a passive artificial companion present that the children were familiar with. A few children in each class had already taken Little Donkey home for a sleepover, but most children only knew him from stories and playing with him shortly and because the teacher told them about the project.

![Figure 5 – Little Donkey](image)

When reviewing this option we considered if the situation with Little Donkey was not too different from the situation Furby would be in. To be able to do a good comparison between an active and a passive artificial companion both play situation have to be as similar as possible. We felt that since not all children had taken Donkey home yet and the project only recently started, that Donkey was a good option to use as the passive artificial companion.

**Simple**
The questions should be well formulated up front, so that any ambiguity about the meaning of the question is avoided. The questions should be short and simple, specifically directed at our target group.

**Duration**
The sessions should be as short as possible; we noticed during the second case study that a duration of 10 minutes would be the maximum. This way the children would stay focused, and won’t be distracted preventing ambiguities in the results.

**Card sorting task**
The card sorting task that we reviewed and tested in our second case study would be very useful for a part of our research. We can use this test to understand how children order certain objects, what place Furby takes in and how they see Furby.

It would be a good idea to use this test for another toy, so we can compare those results to the Furby results. And see if there is a difference between Furby and another toy. Little Donkey would be great for doing this, since the children already know him and therefore can judge it properly.

The design of the cards should be in such a way that the comparison is as clear as could be. We have to exclude as much as possible the chance that children will choose based on the looks of items.

**Longer acquaintance with Furby**
In our second case study it turned out that the children didn’t have enough time to properly get to know Furby to be able to judge it properly.

In an ideal situation they should be able to play with Furby for at least a week. This way ‘the new and exciting’ would be worn off and they will be able to judge Furby more as if it is one of their other toys that they’ve known and played with for a longer time.

We took the previous into account and came up with a research design that is described in the following chapter.

**EXPERIMENT**
We want to research the difference in user experience, play form and perception between passive and active artificial companions.

**Artifact(s)/Creature Design**
For our research we are using the Emoto-Tronic Furby as an active artificial creature, they have an emotional face and voice recognition software to respond to user input. Furbies have stroke sensors on the back, front and sides, so they can be petted, stroked and held by children. Next to that they can be fed by putting something into Furby’s mouth. Furby can respond by, moving its eyes, ears, head-tail, and body and making sounds. Furby can talk, sing and make noises. When Furby is still in its infant stage (children haven’t played with it for long) Furby speaks Furbish, a special language with its own dictionary and grammar. When it grows up, it seems to know more and more English.

In one classroom we will place a Furreal Friends polar bear. This is because there were not enough working Furbies available at the time of the experiment, but also because it might provide an interesting comparison between two active artificial companions that interact in slightly different ways and have different looks.

The Furreal Friends polar bear has a mouth sensor so children can feed it. It can move its face and arms and can make baby like sounds.

![Figure 6 – Emoto-tronic Furby and Furreal Friends Polar Bear that we used in our experiment at Dalton elementary school ‘de Klipper’.](image)

As a passive artificial companion we use the previously mentioned Little Donkey, a plush animal that the children are slightly familiar with and that would be available to them about the same amount of time as the Furby.

**Test location/Environment**
The test location is elementary school ‘de Klipper’ in Berkel & Rodenrijs, the Netherlands. This is a Dalton school, which is an educational system that encourages
children’s natural instincts and stimulates decision making and planning. Children can choose what tasks to do each day from kindergarten on [7].

Participants/ Sample/Test group
Our research will be carried out in the first two classes (kindergarten), with children aged 4-6 years, both boys and girls. The school has 4 kindergarten groups. This number of classes gives us the opportunity to try out different methods. All classes had children aged 4-6 years. On average there are 28 children in each class. During our research there were fewer children present, because of illnesses.

Methods and Procedures

Part 1 - Play
The classes get a Furby to visit their classroom for (at least) a week. All classes will have an active Furby (responding to input from the children). It is possible that a single class gets a Furreal Friend polar bear to visit instead of a Furby.

During the week children play with the creature, without guidance. Help and guidance from a teacher is allowed, but it is not the idea that a teacher is constantly initializing or guiding the play. This is to prevent that the children won’t react in a natural intuitive way, but by how the teacher tells them to play.

During this period teachers observe the play and fill in a short questionnaire every day. It is not necessary that the teacher is constantly observing, it is intended that the teacher has an idea of how children play with the creature and are able to answer the questions in our questionnaire.

Part 2 - Experiences

Observation halfway during the experiment
After a week (maybe longer), we will join the school for one day to do observation and see if everything goes without problems. Preferably we would like to ask the children questions about other toys, this to get an idea of how they see and experience other toys. These are short questions, in a playful way, individually, in groups or in the classroom.

Teachers
After the test week we will discuss with the teachers how the experiences were and how the children have played with the Furby based on the questionnaires they have filled in.

We hope to find out whether the presence of the electronic interactive features of the Furby has had an influence on how the children played with the toy. We would like to know whether children for example used Furby with other toys and if children were guided by the electronic possibilities in their play, or if they made up their own games.

Students
Besides the discussion with teachers, we hope to have the opportunity of discussing the play period with the children as well as the teachers.

There are a few possibilities to do this: Individual, in small groups or in the classroom. We would like to do this in a way that is as playful as possible.

Based on the Kahn research [6] and our previous case study we will do a card sorting task. The cards will have pictures on it of a computer, robot, plush animal, real animal and children. Pairs will be formed of these cards. For every pair, children have to indicate which object is more like a Furby. This is to create an image of how children place a Furby in their world.

Data analysis/assessments
The teachers will fill in questionnaires (preferably each day) that can be processed. In the questionnaires the teachers are asked to fill in their experiences. Since these are not values that you can do calculation on, these questionnaires have to be read and processed and then reviewed.

The researcher observed the children, outcome of these observation are noted and afterwards reviewed in a similar way as with the teacher observations.

The results of the card sorting task are written down during the sessions and afterwards statistically analyzed. There are audio recordings of all conversations.

RESULTS
This chapter describes how the experiment was conducted, what went right and wrong and the test results an interpretation of the results.

Card Sorting Task
We did two card sorting tasks during this research, one where we compared Little Donkey to various artifacts and on where we compared Furby to various artifacts.

Little Donkey
We did the card sorting both individual and in front of the whole class. Little Donkey was not present during the test, so it could only be mentioned by name.

The computer card was not included in the Little Donkey card sorting task, but it was used in the Furby card sorting task. This was because our time was limited and we expected that the difference between Little Donkey and a computer was so big that we could predict the outcome upfront. We expected that a strong minority of the children would see Little Donkey as more like a computer than any other one of the artifacts. Ideally we would have included this card to see if our expectation was right, but as explained earlier, due to time issues we had to make a choice to either interview fewer children or give them less tasks. We chose the latter.

The card sorting with a whole class was a little problematic, but necessary since we didn’t have the time and opportunity to ask all children the questions individually. In one class we asked all the children to raise their hands if they thought A was more like Little Donkey and then asked to raise hands if they thought B was more like Little Donkey. This didn’t work that well, a lot of children raised hands for both options and other children were highly influenced by the choices
their friends made (Even though they were clearly told there was no wrong answer).

After coming to the conclusion this wasn’t the best way to do the classical card sorting, we had the luxury of having two other classes where we could do a slightly different variation. This time we asked the children to stand and stand on one side of the room if they thought A was more like Little Donkey and stand on the other side if they thought B was more like Little Donkey. This was a better setup, but there still seemed to be some misunderstandings and influence by friends. We chose not to include the results from the class card sorting tasks, we considered these results not reliable enough.

The individual card sorting did not go entirely as planned, but better than the class card sorting sessions. Maybe partly because of the absence of Little Donkey, the questions were sometimes misunderstood. The question asked for each pair was if Little Donkey was more like card A or card B. Some of the children seemed to interpret the question as which object do you like better (to play with), A. or B. This probably caused some erratic results.

The above graph shows the results of the individual card sorting task were children were asked if Little Donkey was more like A. or B. This probably caused some erratic results.

For 4 of the 6 comparisons there was no remarkable difference between one and the other. There were equal numbers for the couple plush animal vs. robot (7 vs.7), real animal vs. robot (7 vs.7), and almost equal numbers for the couple robot vs. children (8 vs.6) and children vs. animal (8 vs. 6).

For the couple real animal vs. plush animal, plush animal scores higher (4 vs. 10), meaning children thought of Little Donkey as more like a plush animal than a real animal. This was expected since Little Donkey is a plush animal. It is however interesting that still 4 out of the total 14 children chose real animal. This might’ve been caused by misinterpretation of the question.

When children are asked if Little Donkey is more like children or like a plush animal it is quite remarkable that a majority (10 vs. 4) chooses children instead of a plush animal. This would mean that children thought of Little Donkey as more like a child than like a plush animal even though Little Donkey is a plush animal.

Even more interesting when put next to the previous result were Little Donkey was seen as more a plush animal than a real animal. From these results we can conclude that the children in this experiment recognize certain values to Little Donkey that make it more similar to a child than a real animal when compared to a plush animal. This however doesn’t completely agree with the result in the comparison between children and real animal, were there is no significant difference (6 vs. 8).

When we look at the total number of times the different objects were chosen, we see that the card that is chosen the most is children, that might be because children see Little Donkey as more like a child since he can go home for sleepovers and basically children play with Donkey in the same way as they would play with friends.

**Furby**

The individual card sorting task with Furby was conducted one week later and went a lot better than with Little Donkey. Having learned from the previous test, we included an extra card with Furby on it, so the children had a clear visual image of the question that was being asked.

We didn’t do the class card sort with Furby because of lack of time and because of the seemingly invalid results with Little Donkey.
When the children were asked if Furby was more like a plush animal, the plush animal scores rather high compared to a robot (14 vs. 3), a computer (14 vs. 2) and a child (11 vs. 4).

But when we look at the comparison between a plush animal and a real animal, a large majority of the group (13 vs. 1) answered that Furby is more like a real animal. When asked an explanation an answer that was heard multiple times is “because Furby can move”. So we can say that Furby is seen more like a real animal than a plush animal but more like a plush animal than like a robot, computer or child.

Real animal has the highest positive difference in all comparisons, except when compared to a child, then the difference is a little less (9 vs. 7). When asked for an explanation, children said that was because Furby can talk and real animals can’t.

Child doesn’t receive the highest scores but is chosen quite frequently. Child scores higher than robot (10 vs. 5), higher than computer (11 vs. 5) and slightly lower than a real animal (7 vs. 9).

Furby is almost never seen as ‘more like a computer’. Only in comparison to a child (kind), the score is 2-3 votes higher (coming to a score of 5).

Furby is rarely seen as ‘more like a robot’, except when compared to a computer (12 vs. 3). Following these results we can say that the test persons thought of Furby as more like a robot than a computer.

Viewing the total comparison we can come to the following order of which objects are more like Furby: Real animal, plush animal, child, robot, and computer.

When looking at the graph below, showing the total number of choices the children made for the different object we can draw the same conclusion.

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**Figure 9 – Results of the individual Furby card sorting task**

The above graph shows all the different card pairs and what choices the children made.

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**Figure 10 – Total times objects were chosen during the individual Furby card sorting task**

**Furby vs. Little Donkey**

After more than a week of playing, we asked within all the classes whether they liked Little Donkey or Furby better. We did this by placing Furby on one side of the classroom and Donkey on the other side and then asking the children to stand on either side. As shown below, sometimes children liked both or didn’t know what to pick (for no particular reason). There are a few risks to this approach; it is likely that some children are influenced by peer pressure, causing them to choose what their friends choose. We have to note that when performing this part of the experiment, we did notice some children might have been influence by their friends, we did not have the feeling that a majority of children was influenced by what their friends choose. Most of the choices that were made seemed objective.

**Figure 11 – Results of the Classroom Question, who do you like better: Little Donkey or Furby?**

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Outcome was that almost all children liked Little Donkey better. We asked them why and some children answered it was because Little Donkey could go home with them for sleepovers, because he was softer and you could do more with him.

**Observations**

**Teacher**

There were big differences on how teachers treated our research. One teacher involved Furby in every activity in the classroom. During circle activities “Furby was the only one allowed to talk without raising its hand” the teacher told me. In another class the teacher had Furby sitting at a shelf below the blackboard, clearly present, but most of the time children had to ask before they could play with it. One teacher placed Furby in the doll corner (corner or part of the classroom where children can play with dolls, plush animals, usually furnished as a living room, with a small table, chairs, bed etc.) where children could pick it up and play with it whenever they were playing in the doll corner. In the fourth classroom it was unclear how the teacher placed the Furreal Friends polar bear in the classroom.

All teachers filled in the questionnaires, some thoroughly, others barely. Interesting outcome of the questionnaires was that in almost all classes, the first day(s) children seemed interested in Furby and wanted to play with him, but after a few days the Furby didn’t seem so interesting anymore and only a few children kept playing with it. Multiple times we heard the remark that Furby didn’t respond that well to what the children said. That was partly because of the noise in the classroom and of the wrong sentences used by the children. Because of these problems children didn’t understand Furby and sometimes mentioned that Furby was tired.

Almost all questionnaires mentioned that mainly girls played with the Furby and that they played alone. According to the teacher Furby was used as “a plush animal that makes noises”. In multiple questionnaires we read that children liked to read stories to Furby or played with it as if it was a baby. After a few days a teacher mentioned that the children started to treat Furby more and more as a plush animal.

One interesting comment that someone made (outside of the questionnaires) about the class that had the Furreal Friends polar bear in it was that the boy who was playing with it at the moment had some behavioral issues and that it seemed or could be a good toy for those children because of the stimulus the toy gives, it actually responds to the user, something that apparently works well for some children.

In general, the questionnaires did give me some guidance in determining how Furby was used and to confirm my own observations. They didn’t show any new facts or thing we didn’t expect upfront.

**Researcher**

Our own observation took place on two days during the research period. During these observations we visited all the classes and looked at how children were playing with Furby, what kind of play they were engaged in, what part of the class they were playing in and with how many children they were playing. The outcome of these observations didn’t show any new results compared to the conversations we had with teachers and the filled-in questionnaires. One interesting thing is that we noticed that children liked that it was possible (but not meant to be) to pick on Furby’s beak, causing it to look like it could stick out its tongue. Also closing and opening its eyes seemed entertaining. The mechanical possibilities of Furby that were never designed to be used in that way seemed far more interesting than the designed features of Furby.

**Little Donkey Diary**

When children take Little Donkey home with them for a sleepover, they take him in a small suitcase that contains a pajama, a tooth brush etc. for Little Donkey; it also contains a diary in which they can write down their experience with Little Donkey.

One of the teachers provided a copy of the diary so we could review and read the adventures the children had with Little Donkey.
The diary tells about the activities children did with Little Donkey, written by their parents. They mainly describe everyday activities; playing in the playground, watching television, going to their grandparents, eating and almost every diary entry tells about brushing Little Donkey’s teeth and where he slept.

**Furreal friends polar bear vs. Furby**

As was explained before, one of the four classes had a Furreal Friends polar bear visiting instead of a Furby. This created an opportunity to see if there was a difference between both companions.

During our observation there seemed to be more mother-father play with the polar bear than with the Furby. Because the polar bear behaves as a baby and you can feed him a bottle, children seemed to respond to this predetermined pattern and treated the polar bear as if it was a baby. They carried it around, gave the bear it is bottle and (unsuccessfully) tried to put it to sleep. The main conclusion is that certain predefined play options (baby like behavior) seem to determine how children play with the object. In our observation we didn’t notice children treating Furby as a real baby. They did try putting it to sleep, but there was a clear difference in how caring they were. With Furby their actions seemed more similar to how children would try to put an older doll to sleep or how they would tell a classmate to go to sleep in pretend play.

**DISCUSSION & FURTHER WORK**

This research showed that children see Furby more as a real animal than a plush animal, but this didn’t make the creature more interesting on the long term.

The electronic features of Furby are interesting at first encounter but wear off quickly and the expectations that the features of Furby create cannot be fulfilled, creating disappointment. In the end most children liked Little Donkey better than Furby.

For further research it would be interesting to do a more thorough follow up on this research. To be able to say more about the relationship of children with their active or passive artificial companion, more in-depth interviews would have to be taken, spending more time with the children.

The choice of companions used should be reconsidered, aiming for an experiment with two companions that children are equally familiar with, spend the same time with and perform the same activities with. Our experiment might have suffered from different views on Little Donkey and Furby caused by the difference in play, situation and period.

Furthermore it would be very interesting to do a more thorough research on more types of artificial companions since there is too little variation in the use of companion robots to conclude which aspects are important for companionship [1].

Next to this research it would be an idea to compare more artificial companions. A way to do this would be to gather reviews on review websites about both passive and active artificial companions.

[dit deel moet nog worden uitgebreid en aangevuld]