MASTER

Your buddy in the hospital

a social robot supporting children diagnosed with Type 1 Diabetes during a period of hospitalization

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Your buddy in the hospital
A social robot supporting children diagnosed with Type 1 Diabetes during a period of hospitalization

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Abstract

Type 1 Diabetes Mellitus is one of the most common chronic diseases amongst children and young adults. Having diabetes requires a large responsibility. With children between the age of 7-12 years old, parents mainly take this responsibility. However, it is important that the children reach a higher level of self-management before they reach puberty. Earlier research suggests that a social robot can contribute to gaining self-management skills. Therefore, in the current study, the (positive) effect of a social robot on the education process during the hospitalization is investigated. First, the perceived importance of different robot characteristics was evaluated in an online questionnaire. Results suggested that this perceived importance differed amongst individuals, and that the expectations of the robot were low. Second, a field study was conducted, where the NAO-robot played a trivia game with eight children with diabetes, and this interaction was video-recorded. After the field study, children filled in a questionnaire and their parents were interviewed. Combining the data provided several findings: movements of the robot were entertaining, children got engaged after a short period of getting used to the robot, emotional expressions contributed to bonding, and not all children and parents appreciated eye-contact. The results of both studies are combined. We conclude that in order to achieve an effective positive contribution of using the robot in hospital context, the robot should show movements and emotional expressions and adapt to the user.

Acknowledgements

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Contents

Chapter 1: General Introduction

Social robots are appearing in society and can be useful in many different domains. Leite, Martinho, & Paiva (2013) identified four main domains in which social robots can have a positive influence: healthcare & therapy, education, work environments & public space and at home. In the current research, the focus is on robots that can be useful in healthcare & therapy.

There are different examples of robots in healthcare & therapy. There has been research on robots that can be used in therapy for children with autism (Robins, Dautenhahn, te Boekhorst, & Billard, 2005) and on robots being a companion to elderly with dementia (Tamura et al., 2004). If robots in the domain of healthcare are able to have a natural interaction with patients, they can have a positive influence (Leite, Martinho, & Paiva, 2013). In order to achieve this, the role and the task of the social robot needs to be clear to the user (Mataric, Eriksson, Feil-Seifer, & Winstein, 2007). In the current thesis, the role of a social robot helping children recently diagnosed with Type 1 Diabetes Mellitus is investigated. Before going into detail in the research aims, a theoretical background on children with diabetes is given.

1.1 Type 1 Diabetes Mellitus

Type 1 Diabetes Mellitus (T1DM) is one of the most common chronic diseases amongst children and young adults (Freeborn, Dyches, Roper, & Mandleco, 2013). T1DM is a disease that is usually diagnosed during childhood or adolescence, which is why it is often called juvenile diabetes. On average, the number of cases of children with T1DM in Europe increases every year with 3.9%. In 2013 there were about 129.000 cases of children under the age of 15 years with T1DM (Patterson et al., 2014).

T1DM is an auto-immune disease, in which the pancreas produces little or no insulin. Insulin is a hormone which allows glucose to enter human cells to produce energy. Glucose is the main type of sugar in the blood, and when a body does not produce insulin, glucose is not metabolized in the cells and remains in the blood. This causes a high blood sugar level, which in the longer term can cause health problems, such as heart disease, stroke, vision impairment, foot ulcers and kidney damage. The cause of T1DM is still unknown. The disease can never fully be cured, but luckily with proper treatment people with T1DM can live a long and healthy life.

Patients with T1DM need to inject insulin as prescribed, measure their blood glucose level frequently to act upon, eat a healthy balanced diet in which they especially count the number of carbohydrates eaten and get regular physical activity. These tasks are hard for young children and therefore parents are often managing the disease (Silverstein et al., 2005). This means that parents take control over all tasks and make sure that their children can function normally in their everyday situation. However, it is important to start early with actively guiding a child to take over some of these tasks and manage their own diabetes.

1.2 Diabetes self-management

Diabetes triggers major changes in the daily life of a child and family and has many physical and psychological implications (Peyrot, 2009). The blood sugar level of a child can be too high (hyperglycaemia) and the blood sugar level can also be too low (hypoglycaemia). Both conditions cause physical complaints for the child, such as feeling dizzy, having a headache or even losing consciousness. Next to the physical condition, the children report mental issues, like worrying about their illness or feeling insecure (Blanson Henkemans et al., 2012).

The number of these complications can be reduced when patients have a higher level of self-management (Looije, Neerinckx, Peters, & Blanson Henkemans, 2016). In other words, when the child is in control over most of the tasks managing the disease. Examples are: checking their own blood glucose or counting the number of carbohydrates of a meal to calculate the amount of insulin that needs to be injected. For these tasks children require a high level of self-management, and the level of self-management is still low in young children (Silverstein et al., 2005).

Therefore, diabetes management in children with older-elementary school age (7-12 years) still mostly depends on their parents (Silverstein et al., 2005). Parents monitor the diabetes regimen and adjust it to school and peer activities. From the age of 12 years and older, children reach their puberty and before that, it is important that children are already involved in active management of the disease. Puberty brings both physiologic and psychosocial challenges and for children with diabetes this has two main consequences. First, insulin intake is related to hormones that increase during puberty and can fluctuate in this period. Second, because children form their own identity, the dynamic between the parent and child changes (Peters & Laffel, 2014). Therefore, it is beneficial to start teaching children how to manage their own diabetes before they reach puberty.

To reach a higher level of self-management, children need knowledge about diabetes and accompanying skills (Roper et al., 2009). They need to be educated by nurses and parents and it is beneficial to share their experiences with peers. According to Looije et al. (2016) there are three main principles for learning self-management. First, a child needs to be intrinsically motivated. Second, children need to be prepared for the changes they will encounter at adolescence. Third, the strategies for attaining self-management need to be personalized, since these strategies depend on the personal and environmental factors of a child.

There are different ways of supporting children in the realization of self-management, and one of them is using technology. According to Blanson Henkemans et al. (2012), children can benefit from social robots offering them motivation and support. A robot can support them in learning self-management skills and gaining insight in diabetes. The robot needs to act as a buddy, and not as a support tool, to prevent stigmatization. We investigated the possibilities of using a social robot to contribute to the educational process of self-management.

1.3 Social robots

Earlier research has delivered guidelines on how to support children in diabetes self-management using a social robot. Looije et al. (2016) indicated that children with T1DM enjoyed activities with a robot in the hospital. They formed a relationship with the robot and gained knowledge about diabetes. Parents and caregivers saw improvements in the mood and openness of the child.

In a study by Kruijff-Korbayova et al. (2015) it was found that children with diabetes who had an interaction with a social robot were more likely to describe the robot as a friend than children who had only seen the robot, but did not interact with it. Moreover, the children interacting with the robot were very willing to talk to the robot about their diabetes, and wanted to talk to the robot more often.

Furthermore, children with diabetes are more inclined to bond with the robot than healthy children are and they can also learn something about their disease and about diabetes self-management from a robot (Looije, Neerincx, & Peters, 2015). Robots have been shown to be effective in education in general. Other studies show that children and students can learn a different language from a robot as well (Kanda, Hirano, & Eaton, 2004; Saerbeck, Schut, Bartneck, & Janse, 2010).

To conclude, results of earlier research suggest that social robots can have a useful, positive interaction with children with T1DM. The question remains what elements of the robot contribute to this positive effect and whether or not the effect is the same with children that are recently diagnosed.

1.4 Research aims

To find out how children between the age of 7 – 12 years old recently diagnosed with T1DM can be assisted at self-management by a robot during a period of hospitalization shortly after diagnosis, the following research question is investigated:

1. How can a social robot effectively have a positive contribution in the education process during the period of hospitalization after diagnosis?

An effective positive contribution can consist of different elements. Each person concerned can have different ideas of when the robot is useful. The child might want the robot to be entertaining, while a paediatrician or diabetes nurse might want to focus more on the aspect of education. Next to this, the robot can show different behaviours or characteristics that can influence the user experience.

As explained in section 1.3, the potential positive effects of robots assisting in learning self-management have already been demonstrated. However, it remains unclear what characteristics of the robot contribute in what way. The goal of this current research is to link different characteristics of the robot to their relevance in this context.

In order to understand the context of a child recently diagnosed with T1DM, we describe the situation a child will encounter after diagnosis in a case study in Chapter 2. In an interview performed with a paediatric diabetes nurse this situation was illustrated.

In Chapter 3, a literature study on different robot characteristics is conducted.

The method and findings of the online questionnaire is reported in Chapter 4. The online questionnaire was sent out to children with T1DM and their parents in order to measure a baseline on the perceived importance of the different robot characteristics for the second experiment.

In Chapter 5 we explain the technical implementation of the characteristics of this robot.

In Chapter 6, the method and findings of the field trial are explained. In this study, we tested the robot during an interaction with eight children with T1DM.

Finally, in chapter 7, we discuss the findings and limitations of the current work and draw conclusions.

Chapter 2: Case study

To be able to answer the research question posed in the previous chapter, it is important that the situation and user needs of a child diagnosed with T1DM is clear. Gelderse Vallei Hospital is exploring the use of a social robot during the period of hospitalization after a child is diagnosed with T1DM, and we focus on the process of diagnosis and hospitalization of this hospital.

In this chapter, we sketch the situation of a young patient recently diagnosed with T1DM in Gelderse Vallei Hospital. In order to fully understand the situation of interest, a paediatric diabetes nurse working at Gelderse Vallei Hospital was interviewed about the procedure of hospital admission, education and evaluation, and the attitude towards using a social robot in this period. The results are outlined in the following subsections. The details of this interview can be found in Appendix A.

2.1 Diagnosis and hospital admission

The process of establishing that a child suffers from T1DM, often starts with a visit from the child and its parents to the general practitioner. The child complains about being thirsty and having to urinate frequently. The general practitioner measures their blood sugar, and when it is too high, the child is sent to the hospital immediately, and is admitted. Parents are stimulated to stay with their child in the hospital during this period.

2.2 Education

At the day of admission, the paediatric diabetes nurse will introduce herself to the young patients and his/her parents. The diabetes education starts the next day, or when a child is in a bad condition or dehydrated, a few days later.

When the child is admitted in the hospital, each day the child and its parents will get education about diabetes and how to handle it. Next to the medical education that the paediatric diabetes nurse and the general nurses in the paediatric department give, there is also a consultation by a dietician and a social worker. The education depends on the age of the child: for children younger than 7 years, all education will be directed to the parents. When the child is older than 7 years the child is progressively included in the education.

The paediatric diabetes nurses try to individualise the diabetes education to the situation of the child. This means that the culture, lifestyle and habits are all considered. This includes other health issues, such as such as autism spectrum disorder, Down syndrome, and allergies.

The education consists of a number of subjects, that are all explained during the period of hospitalization. The order is adjusted to the preferences of the family. When all subjects are covered, the education is evaluated.

2.3 Evaluation

After 4 - 5 days, the nurses need to decide whether the child and its parents are sufficiently well prepared to handle the diabetes at home. Based on an interview with parents and child, the nurse evaluates whether it is acceptable to end the hospitalization period. If the child is between 7 – 12 years old, the paediatric diabetes nurse establishes whether the child is able to explain diabetes to class mates, knows what to do when a high or a low blood sugar level occurs and knows how to act when food contains a lot of sugar. By use of a checklist, the nurse checks if all subjects are clear and understood. If the child is 12 years or older, the child is interviewed, with younger patients the questions are mainly asked to the parents.

2.4 Robot support during hospitalization

Since robots can have a positive influence on children with T1DM, the hospital intends to use a social robot during the hospitalization period. The paediatric diabetes nurse that was interviewed, welcomed the idea, because she has seen the enthusiasm of the children that have interacted with the robot in a previous experiment. It seems a robot could be a buddy for the child that is capable of interacting at the child's level.

The ideal scenario, according to the paediatric diabetes nurse, would be to have the robot interact with the child from the first day of hospitalization. Children could talk to the robot and ask diabetes questions when there is no one around. On a day of education, the robot could strengthen the new knowledge by playing a trivia game, with questions on a certain subject. The nurses would like to have control over the subjects that the robot will cover.

Chapter 3: Robot characteristics

A social robot can show a lot of different behaviours that can contribute to the impression it makes. Based on the literature, we selected eight different characteristics that each can contribute to experiencing a positive interaction with a robot. They are reviewed in the following subsections.

3.1 Emotions

The first characteristic that is considered is showing emotions.

In human-human interaction, emotionally expressive behaviour is very important for communication in an interaction and forming social relationships with your interaction partner (Butler, Egloff, Wilhelm, Smith, Erickson, & Gross, 2003). Robots, however, mimic emotional behaviours in communication, in a way that a human interaction partner can perceive expressiveness (Duffy, 2003).

Robots do not have the same (facial) expressiveness as humans, but, fortunately, there is a wide variety of displays that are interpreted as emotional or affective. For example, Johnson, Cuijpers, and van der Pol (2013) found that human emotions can successfully be perceived in a social robot using only the colour pattern of the eye LEDs.

Humanoid robots also have the possibility to express emotions through body postures and movements. Research by Beck, Cañamero and Bard (2010) indicates that people can successfully recognize emotions portrayed by a body posture of a robot. Furthermore, it has been found that children enjoy a robot that shows emotion through bodily movements (Tielman, Neerinckx, Meyer, & Looije, 2014).

Another aspect of empathic behaviour is reacting to the emotion your interaction partner is feeling. Humans tend to copy emotions from each other (Wild, Erb, & Bartels, 2001). To study what effect a social robot that mimics emotions has, Tielman, Neerincx, Meyer, and Looije (2012) designed a framework in which the robot could adapt its displayed emotions to the ones of the child. They found that children reacted more expressively and enjoyed themselves more during an interaction when the robot adapted its emotional displays. However, in the control condition a non-affective robot was used, so it is unclear if these effects stem from adaptability or from being affective. Still, it seems beneficial for a robot to show emotions.

In a similar study by Leite, Castellano, Pereira, Martinho, and Paiva (2012) it was found that empathic behaviour by a robot in an interaction with a child made the child perceive the robot as more positive. However, they state that this only holds when the empathic behaviour is suitable to the situation and when a robot learns to adjust its strategy to the individual user.

3.2 Gesticulation

Gestures to show an emotion is not the only type of gesturing that a robot can portray. In this section the movements and gesticulation of the robot is discussed.

A human can never stand completely still, even without a clear goal humans will keep moving. We call these movements idle movements. Motions can also be meaningful, and include gesturing. Gestures are an important feature of human communication (Kendon, 1994). Gestures can have a meaning or accompany the speech of a human, the latter are called co-speech gestures.

A robot can also make use of gestures. In a study by Cuijpers and Knops (2015) a robot using either meaningful or idle motions interacted with a human partner. Results indicated that a robot using either type of motions was perceived to be more human-like than a robot using no motions. A robot using meaningful motions was however perceived as more intelligent, both socially and generally, compared to a robot using only idle motions.

3.3 Gazing

In this section a specific type of movement that can be made by a robot is considered: gazing.

Humans can show many different gaze behaviours. Gaze cues play an important role in social interactions between humans (Kleinke, 1986). They can carry intention, attitudes and emotions. When in conversation, gazing can provide information for turn-taking: listeners look at speakers, and speakers end their turn often with a gaze towards the person receiving the turn (Kleinke, 1986).

Gaze cues have been successfully implemented in robots to indicate turn-taking behaviour (Mutlu, Shiwa, Kanda, Ishiguro, & Hagita, 2009). Furthermore, in a study by Ham, Bokhorst, Cuijpers, van der Pol, and Cabibihan (2011) it was found that a robot had persuasive power when gazing at a human partner.

3.4 Intelligence

A robot can be perceived as intelligent by a human partner. In this section the intelligence of the robot in this study is considered. The focus is on two aspects of its intelligence: answering questions incorrectly and exhibiting thinking behaviour.

A robot playing a trivia quiz with a child can be programmed to answer all questions correctly. However, to maintain attention and intrinsic motivation to keep playing the game, it is important that the robot answers some questions incorrectly (Schadenberg, Neerincx, Cnossen, & Looije, 2017). It is also proven to be beneficial to adapt the level of the robot to the level of the child (Janssen, van der Wal, Neerinckx, & Looije, 2011).

The other aspect of intelligence that is considered, is exhibiting thinking behaviour. A robot can give answers to the questions right away, or pretend to be thinking about the question. In a study by Wigdor, de Greeff, Neerincx, and Looije (2016) it was found that a robot that used conversational fillers ("uh") and pensive fillers ("let me think") was perceived as more human-like and likeable by children that played a trivia game with it.

Both answering questions incorrectly and exhibiting thinking behaviour can be considered to affect the perceived intelligence of the robot.

3.5 Personality

Intelligence can be considered to be a part of the personality of a person or robot. Every person has a unique personality, and the way a robot behaves could influence the personality that a human ascribes to the robot.

The personality of a person influences how he expresses himself. For example, extrovert persons move more, move quicker, smile more and have a stronger voice than introvert persons (Borkenau & Liebner, 1992).

In robotics research, personalities are also relevant. Personality expression of a robot affect the user impression of this robot (Kim, Kwak, & Kim, 2008). Moreover, in a study that used an extrovert and an introvert robot, people interacting with the robot generally tend to like the robot with the personality closest to their own (Jung, Lim, Kwak, & Biocca, 2012).

3.6 Role-switching

The next characteristic that is discussed contains an aspect of the interaction rather than an aspect of the robot: role-switching.

When the child has multiple interactions with the robot it is important that the child stays motivated. In a long-term interaction between a robot and a child, role-switching could help keeping the child intrinsically motivated. An example of role-switching could be switching roles between teacher and pupil in a trivia quiz.

In a study where children either interacted with a robot with role-switching, a robot without role-switching or no robot at all, the results indicated that interacting with a robot with role-switching gave the highest engagement levels. This means that role-switching can facilitate long-term interactions between children and robots (Ros et al., 2016).

3.7 Memory

The next characteristic that is discussed also has the possibility to maintain the attention and motivation of the child: the memory of the robot. When the child interacts with the robot for multiple sessions, it is possible that the robot remembers facts from one session and can discuss them with the child in the next session.

In the context of this research a child will interact with the robot for multiple sessions during the period of hospitalization. In a study where children with T1DM interacted with a robot multiple times, it was found that personalization of the robot (referring to the child's interests, remembering the last time a question was asked, taking the child's emotions into account) was beneficial for the interaction. Results indicated that children paid more attention to the robot, and were more social and expressive, compared to children in a long-term interaction with a robot that did not have these features (Blanson Henkemans et al., 2017).

3.8 Self-disclosure

Self-disclosure plays a central role in developing and maintaining social relationships. It is linked to a person's likeability (Collins & Miller, 1994). People who disclose a lot tend to be liked and trusted more than people who disclose less.

The same effect holds in human-robot interaction. Robots that self-disclose are more likeable than robots that only give task-related information (Siino, Chung, & Hinds, 2008). Furthermore, in a study that used a robot to motivate children with T1DM to keep a diary, results indicated that a robot that disclosed more, stimulated the children to share more personal information as well. The robot in this study encouraged the child to write more information in their diaries (van der Drift, Beun, Looije, Blanson Henkemans, & Neerincx, 2014).

3.9 Summary

There are a lot of different robot characteristics that are shown to contribute to a positive and natural interaction with a human. We have established the relevance of eight robot characteristics that could play an important role in the context of hospitalization for children recently diagnosed with T1DM. In the next chapter, we explain how we investigated the perceived importance of these characteristics in an online questionnaire.

Chapter 4: Online questionnaire

The goal of the online questionnaire was to establish a baseline of perceived importance of different robotic characteristics of the children and their parents.

4.1 Method

The online questionnaire was used as an explorative method to gather data on the perception of the robot characteristics. Two different questionnaires were employed: one designed for children with diabetes between 7 – 12 years old and one for their parents.

4.1.1 Participants

The questionnaire directed at children was sent to 30 children, 3 of which completed it (response rate = 10%). Two of the participants were 7 years old and the oldest participant was 8 years old. They all were male.

The questionnaire directed at parents was also sent to 30 people, 8 of which completed it (response rate = 28%). It was completed by 7 female parents and 1 male parent. The mean age of the parents was 41.9 years old with an age range between 32 and 48 years old (*SD* = 5.6 years). Their children with diabetes type 1 had a mean age of 8.9 years old and were within an age range of 7-12 years old (*SD* = 1.5 years).

All participants were (parents of) patients of Gelderse Vallei Hospital.

4.1.2 Materials

The online questionnaires (see Appendix B) were designed in Google Forms (www.forms.google.com). They started with an informed consent form for parents to read and sign. After the consent form, both questionnaires were divided into two sections. The first section concerned the participants' experience with and impression of robots in general and the second section measured perceived importance of the characteristics of a robot within the context, (see Chapter 3), using a 5-point Likert Scale. In the questionnaire for children all points of the Likert Scale were given a label (*A lot*, *quite much*, *neutral*, *a little bit* and *not at all*). In the questionnaire for parents, only the extremes were labelled (1 = *strongly disagree*, 5 = *strongly agree*).

Before the questions of the second section were shown, a clear description of the robot was given, including a picture of the robot as shown in Figure 1. Next to this description, the context was given: the robot would be used in the period of hospitalization, shortly after diagnosis of diabetes type 1. The participants were asked to imagine this robot in the given context while answering the questions of the second section.

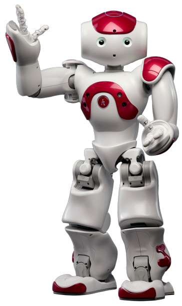

Fig. 1: NAO robot as shown in the online questionnaire

4.1.3 Procedure

To invite parents and children to fill in the questionnaire, all parents of patients between 7-12 years old of Gelderse Vallei Hospital received an email in which they were asked to fill in a questionnaire and ask their child to fill in the other questionnaire. To ensure privacy, a personal number was included in the email. If more information was required about the research or when the parents were interested to participate in the field study, the parents could fill in their personal number and did not have to fill in their email-address.

4.2 Results

4.2.1 Children's questionnaire

The first section of the children's questionnaire measured the perception of robots in general. Noticeable, these perceptions differed between the three children. The three participants agreed most on the question whether they thought robots are scary and they tended to say no. The other perceptions varied between the participants, see Table 1. None of the three participants answered "neutral" to any of these questions.

Table 1: Perceptions of robots in general, amount of responses children

	A lot	**Quite much**	**Neutral**	**A little bit**	**Not at all**
I think robots are useful		2		1	
I think robots look like humans		1			2
I think robots are intelligent	1	1		1	
I think robots are friendly		2		1	
I think robots are scary				2	1

Before the questions of the second section, they were asked to imagine a robot to be employed in the context of the week of hospitalization. Looking at the questions concerning emotions of the robot, the participants believed that it is more likely for the robot to feel happy, than it is to feel sad or angry and in the least place scared. They generally liked it when the robot was in the same mood as they were themselves. These results can be found in Table 2.

Table 2: Emotions of the robot, amount of responses children

	A lot	Quite much	Neutral	A little bit	Not at all
I think the robot can be happy		1	1	1	
I think the robot can be sad		1	1		1
I think the robot can be angry			2	1	
I think the robot can be scared			1	1	1
I like it when the robot has the same mood as me	1	1		1	

The other questions concerned other characteristics of the robot, such as movements, intelligence and bonding. It can be noticed that the participants like it when the robot moves, and tend to like eye contact as well. All three participants considered the robot to be generally intelligent and able to understand the child. These children liked it when the robot remembers their name and two of them would like to be friends with the robot (see Table 3)

Table 3: Movements, intelligence and bonding, amount of responses children

		A lot	Quite much	Neutral	A little bit	Not at all
Movements	I like it when the robot moves	1	2			
	I like it when the robot looks at me	2		1		
Intelligence	I think the robot is intelligent		1	2		
	I think the robot is able to make mistakes		1		1	1
	I think the robot understands me		2		1	
Bonding	I like it when the robot remembers my name	1	2			
	I like it when the robot knows my hobbies	1	1			1
	I want to be friends with the robot		2	1		

4.2.2 Parents' questionnaire

Similar to the children's questionnaire the first section in the parents' questionnaire measured the perception of robots in general. Several statements were measured on a 5-point Likert Scale. In Figure 2 an overview of these statements is given. As can be noticed, the statement "I think robots are scary" differs significantly from the midpoint of the scale (p = 0.005; t(7) = -4.0; d = -1.4) as does the statement "I think robots look like humans" (p = 0.001; t(7) = -5.2; d = -1.7).

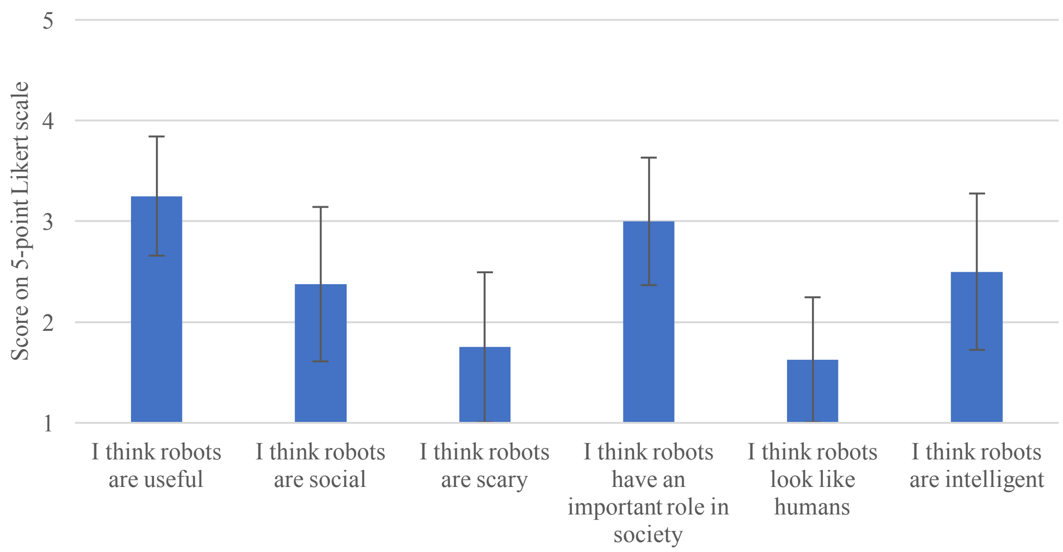

Fig. 2: Perceptions of robots in general by parents. Averages on a 5-point Likert Scale with 95%-Confidence Intervals.

In the second section the perceived importance of different robot characteristics in the given context was measured. In the three questions about emotions (see Figure 3) the statement "I think the robot can feel emotions" differs significantly from the midpoint of the scale (p = 0.004; $t(7)$ = -4.4; d = -1.5). Furthermore, although not significantly different, parents tend to say that showing emotions is important, but they are slightly less certain that the robot can show emotions (p = 0.11; $t(7)$ = -1.8; d = 0.8). The same holds for the perceived importance of having a personality and the perceived possibility that a robot has a personality (p = 0.08; $t(7)$ = -2.0; d = 0.8).

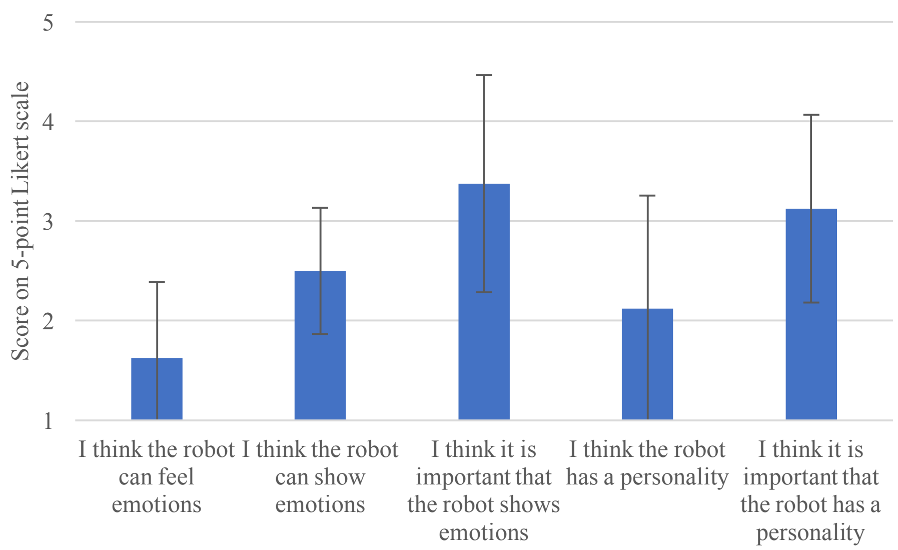

Fig. 3: Perceptions of robot emotions and personality by parents. Averages on a 5-point Likert Scale with 95%-Confidence Intervals.

As shown in Figure 4, parents considered movements when interacting important and this differs significantly from the midpoint of the scale (p = 0.02; $t(7)$ = 3.0; d = 1.0), as well as making eye contact (p = 0.006; $t(7)$ = 3.9; d = 1.4). The result on the statement "I think that the robot thinks about its behaviour" was significantly lower than the midpoint of the scale (p = 0.02; $t(7)$ = 2.6; d = -0.9).

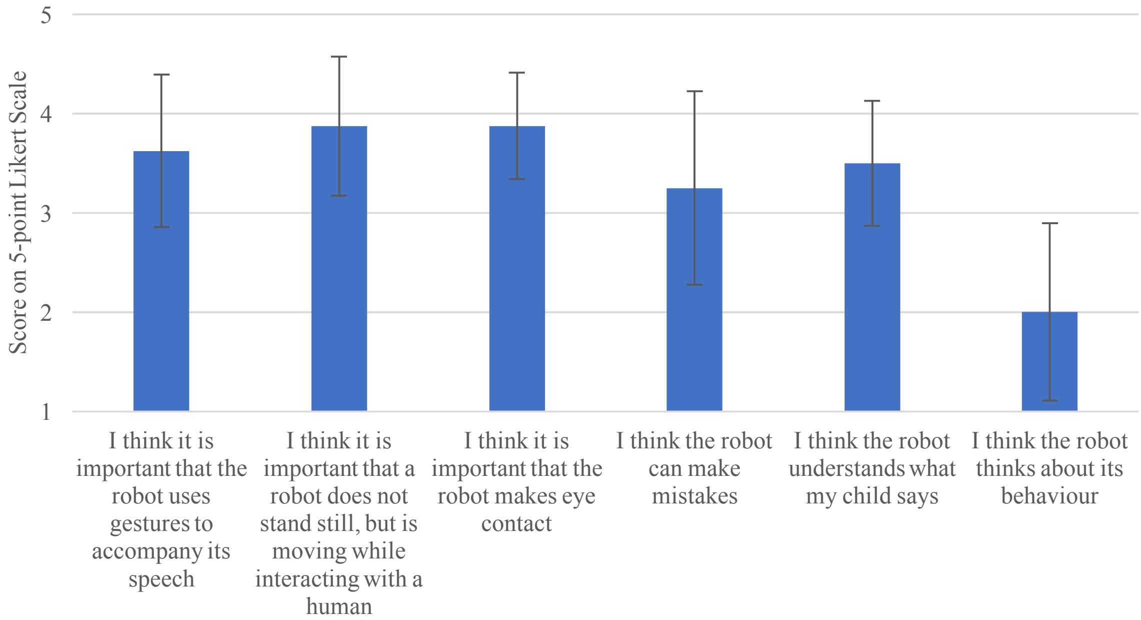

Fig. 4: Perceptions of robot movements and intelligence by parents. Averages on a 5-point Likert Scale with 95%-Confidence Intervals.

The last questions were about memory of the robot and bonding between the child and the robot. These are shown in Figure 5. Parents do not think it is scary if their child would become friends with the robot. This result differs significantly from the midpoint of the scale (p = 0.001; $t(7)$ = 5.2; d = -1.8). Furthermore, parents think it is important that the robot remembers their child. This results differs significantly from the midpoint of the scale as well (p = 0.002; $t(7)$ = 5.0; d = 1.8). They generally do not think it is scary if the robot remembers an interaction.

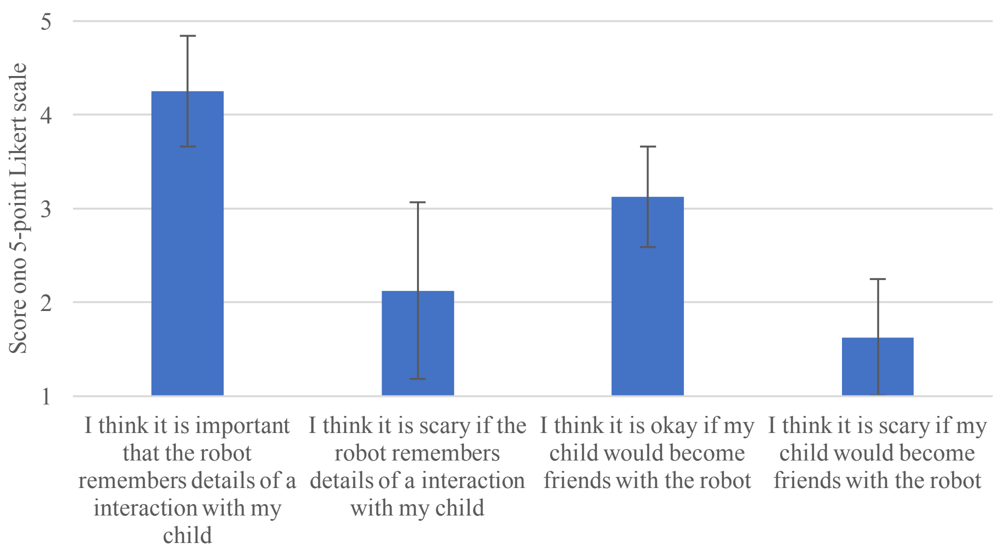

Fig. 5: Perceptions of robot memory and bonding by parents. Averages on a 5-point Likert Scale with 95%-Confidence Intervals.

The parents were also asked with whom the robot could share information about the interaction that it remembered. The options given were: paediatrician, paediatric diabetes nurse, parents, psychologist, social worker and nobody. Parents could check as many boxes as they liked. The paediatrician was mentioned 5 times, parents were mentioned 5 times, the paediatric diabetes nurse was mentioned 5 times and the psychologist was mentioned once. One participant did not check any boxes but mentioned that it should be discussed with the child.

A complete overview of all averages and standard deviations of all statements can be found in Table 4.

Table 4: Averages and standard deviation of all questions answered by parents

		Average	**Standard deviation**
Perception of robots in general	I think robots are useful	3.25	0.71
	I think robots are social	2.38	0.92
	I think robots are scary	1.75	0.89
	I think robots have an important role in society	3	0.76
	I think robots look like humans	1.63	0.74
	I think robots are intelligent	2.5	0.93
Robot emotions and personality	I think the robot can feel emotions	2.5	0.77
	I think the robot can show emotions	1.63	0.63
	I think it is important that the robot shows emotions	3.38	1.09
	I think the robot has a personality	2.13	1.13
	I think it is important that the robot has a personality	3.13	0.94
Robot movements and intelligence	I think it is important that the robot uses gestures to accompany its speech	3.63	0.77
	I think it is important that a robot does not stand still, but is moving while interacting with a human	3.88	0.70
	I think the robot can make mistakes	3.88	0.97
	I think the robot understands what my child says	2.5	0.63
	I think the robot thinks about its behaviour	2	0.89
Robot memory and bonding	I think it is important that the robot remembers details of an interaction with my child	4.25	0.59
	I think it is scary if the robot remembers details of an interaction with my child	2.13	0.94
	I think it is okay if my child would become friends with the robot	3.13	0.54
	I think it is scary if my child would become friends with the robot	1.63	0.62

4.3 Discussion

This study was performed to establish a baseline of the perceived importance of different robot characteristics. In general, it seems that opinions differ a lot between the three children, and that the parents have high expectations of the robot.

4.3.1 Children's questionnaire

In Table 1 the responses of the participants on general statements of robots are shown. There is not much agreement between these three participants, except on whether the robot is scary, which is not the case. From these data, it can be concluded that opinions about robots differ. The three participants tend to say that they robots are useful, intelligent and friendly, and do not look like humans. However, it is interesting to notice that none of the participants choose *neutral* as an answer, suggesting that they have either a more positive or negative impression of robots, but not a neutral one. This indicates that they always have an opinion.

The next results consider a robot in the current context. When asked about the emotions a robot could experience (see Table 2), it is interesting to notice that there seems to be a clear order in which the participants perceive the robot to be able to experience the emotions. They are more sure that a robot can be happy, than they think that the robot can be angry or sad, and the perception of the robot being scared is even lower. It could be that they perceive the robot as friendly, after reading the context and seeing the picture, and therefore attribute positive emotions to the robot.

In the next questions about the robot (see Table 3) we can see that these participants suppose that they would like it when the robot moves or makes eye contact. This corresponds with the findings of Tielman et al. (2014), who stated that children enjoy movements of the robot. What is further interesting about these findings is that the participants seem to be open-minded about bonding with the robot. In different studies, it is shown that children are able to connect with a social robot (Kanda, Sato, Saiwaki, & Ishiguro, 2007; Kruijf-Korbayova et al., 2015).

4.3.2 Parents' questionnaire

In the questionnaire for parents, the impression of robots in general is first evaluated as well (Figure 2). These participants do not think that robots look like humans, suggesting that when these participants are asked to think of robots in general, they either do not picture a humanoid robot, or they think humanoid robots do not look like humans. Whatever robot they picture, some of the participants think robots are useful, intelligent and have an important role in society. They are not scared of robots, suggesting that the participants are open to using robots, but still sceptical.

When presented with a picture and information about a robot in the current context, the participants remain sceptical. The results regarding emotions and personality (Figure 3) show that the parents tend to think it is important that a robot shows emotions or has a personality, but are not sure whether the robot can show emotions or has a personality. This could mean that the parents think that the robot will not be able to match their expectations and this needs to be taken into account when designing the robot.

The high expectations of the robot become clearer in the questions concerning the other robot characteristics (Figure 4). Parents think that it is important that the robot uses gestures, moves during the interaction and makes eye-contact. Most of the suggestions of robot characteristics that are given in the questionnaire are perceived as important by the parents. This can either mean that they just accept all suggestions given because they do not know much about robots, or that they truly consider these characteristics to be important. It could also be a combination of both explanations.

Additionally, the parents perceived the fact that the robot remembers details from the interaction their child to be important. There is no clear preference for the person the robot could share the data with, which suggests that this should be personalized per child.

4.3.3 Limitations

The biggest limitation of this study is the number of participants. If more parents and children could give their opinion about a robot in this context, there would be more different useful insights. The current results suggest that perceptions and preferences depend on an individual. With more participants, we could measure more different opinions and see which opinions appear the most frequent.

Because we used an online questionnaire, the participants did not see the robot, neither did they interact with it. All questions are answered based on an explanation of the context and a picture of the robot. This is a limitation, because there is no exact way of measuring whether the idea the participants have of the robot matches reality. If they had the chance to interact with the robot, or witness an interaction the results would be more trustworthy.

Chapter 5: Technical implementation

The technological part of the field study consists of a computer, a tablet and a 60-cm tall humanoid NAO robot developed by Softbank Robotics, all on the same network. Furthermore, a combination of Python, HTML and JavaScript was used. All scripts can be found in Appendix C.

In this chapter, the implementation of all characteristics as explained in chapter 3 is further explained. Before explaining the implementation of each characteristic in detail, the trivia game that was played in the field study is first explained to be able to place the characteristics in context.

5.1 Trivia game

In the designed interaction, the robot played an interactive trivia game with the child, using a tablet on a see-saw in-between the robot and child (see Figure 6). The child reads a question and flips the tablet to let the robot choose an answer. After this, the robot reads a question and flips the tablet to let the child choose an answer. They each answered six questions in this way. The questions were both diabetes and non-diabetes related.

Fig. 6: Tablet on the see-saw, used to play the trivia game.

5.2 Emotions

For the current research, the NAO robot showed two different emotions: happiness and sadness. Both emotions were shown using two strategies simultaneously.

The first strategy used was showing emotions by using the colour of the eye LEDs of the robot. According to Johnson, Cuijpers and van der Pol (2013) happiness is associated with a yellow colour and sadness is associated with blue. Therefore, the NAO robot was programmed to change the colour of its eye LEDs according to its emotional state: yellow (RGB: (255,255,0)) when happy and blue (RGB: (0,0,255)) when sad. In a regular state, the colour of the eye LEDs was white (RGB: (255,255,255)).

For the second strategy gestures that supported the emotions were used. When the robot's emotional state was happy, it made a cheering gesture: throwing its arms in the air and cheer. When the emotional state was sad, the robot's head was lowered and the head shook no. Next to this, in the sad emotional state also the body posture of the robot changed: it became more collapsed. In Figure 7a the happy gesture of the robot is shown and in Figure 7b the sad gesture is shown.

In the Python program that operated the robot two functions were created: *happy()* and *sad()*. In these functions the eye LEDs and the gestures were defined. When the robot answered a question correctly, *happy()* would run. When it answered a question incorrectly, *sad()* would run. To simulate empathic behaviour, the robot showed the same emotions reacting to questions the child answered: *happy()* when the child answered correctly and *sad()* when the child answered incorrectly.

5.3 Gesticulation

The NAO-robot showed motions in two categories: meaningful and idle. The meaningful motions that were part of the interaction were *cheering*, *looking down and shaking its head*, *thinking* and *flipping the tablet*. *Cheering* and *looking down and shaking its head* accompanied the emotions happy and sad, as explained in the previous section. The *thinking* gesture was executed after the robot was asked a question. Its right hand moved towards its head and its fingers closed and opened, simulating a "head scratching"-movement, see Figure 7c. For the *flipping the tablet* motion the robot went in crouch position, stretch its right arm under the tablet, and stand up again, which made the tablet flip towards the child, see Figure 7d.

a b c d

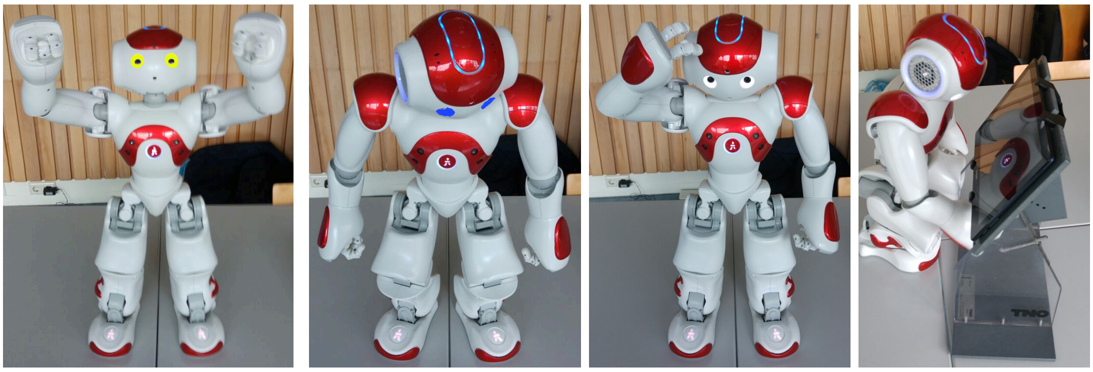

Fig. 7: Movements of the robot: happy, sad, thinking and flipping the tablet.

The robot also showed idle motions, when "doing nothing" (for example when the child was reading a question). These consisted of slight randomized movements of its legs and arms. The robot leaned towards the right or left side and moved its arms and fingers. To create these motions the *autonomous life* module developed by Softbank Robotics was used. This module not only controls these movements, but also controls the "blinking" of the eye LEDs and gazing behaviour, which is explained in more detail in the next subsection.

5.4 Gazing

The main gaze behaviour of the robot was regulated by the *autonomous life* module developed by Softbank Robotics. This module lets the robot continuously look for a face. When it has found a face, it tracks this face for a little while and after that it looks at something else again, to imitate natural gazing behaviour.

To support the *autonomous life* module and the natural gazing behaviour, some extra gaze cues were programmed in the Python script, to make it look natural. When reading a question to the child, the robot looked at the tablet, to add to the illusion that the robot was reading from the tablet. After the question was read, the robot attempted to make eye-contact, to indicate that it was the turn of the child to answer the question. This fits the turn-taking behaviour of making eye-contact.

5.5 Intelligence

In the theoretical background of intelligence as described in Chapter 3, two aspects of intelligence are considered: answering questions incorrectly and imitating thinking behaviour. Both aspects are implemented in the robot.

The robot answered six questions in the trivia game, three were diabetes-related and three were non-diabetes related. To prevent confusion about diabetes-related questions for the children, the robot answered these three questions correctly. The robot answered two of three non-diabetes related questions incorrectly. We did not adapt the number of questions answered incorrectly to the level of the child, because there were not many questions in the game and we wanted to keep the game characteristics constant between all participants.

Furthermore, the robot also exhibited thinking behaviour. After each question that the robot had to answer, it made a thinking gesture (see section on gestures) and a random pensive filler of the following three options: “Uhm, let me think”, “This is a difficult question”, “I might know the answer if I think about it”.

5.6 Personality

For this study, we have chosen not to adjust the personality of the robot to the participants. The robot behaved in the same way with each participant. Instead, we asked the participants and their parents to describe the personality of the robot and to comment on that.

5.7 Role-switching

The trivia quiz was played using a tablet on a see-saw that could be flipped to the person/robot sitting across, see Figure 6. In this section, it is explained how we used the tablet to design the trivia quiz, including role-switching.

The set-up of the game was as follows: a question was shown on the screen for the child to read, as shown in Figure 8. When the child was ready with reading he/she pressed a green button on right side of the tablet that said *Done with reading* and after that flipped the tablet towards the robot. The robot answered that question by telling the answer and report whether the answer was right or wrong. Then, the robot read the question that appeared on the screen and flipped the tablet towards the child. The child could re-read the question and answer by pressing the answer on the tablet. Feedback about the correctness of the answer appeared on the screen, after which the next question appeared. The child then read that question for the robot. This cycle repeated until all questions were answered.

Fig. 8: Interface of the trivia quiz

To design this interaction, the computer runs a webserver in Python (see Appendix C3), which connects to the NAO robot and serves a web page to the tablet. The HTML-interface, running in a web browser, showed the quiz questions on the tablet. The questions were specified in a JavaScript-file (see Appendix C4). The input from the HTML-interface (pushing the button *done with reading* or choosing an answer) made the JavaScript-file request a specific web address on the server to which Python responded by sending instructions to the NAO robot. In this way, the robot would start “thinking about the question” whenever the button *done with reading* was pressed and the robot could react on the answer that a child had given to the question.

5.8 Memory

As the field study consisted of only one interaction, no memory was currently implemented in the robot.

5.9 Self-disclosure

Self-disclosure was implemented by having the robot introduce itself at the start. The robot asked the children for their age, hobbies and whether they had siblings and it also shared all this information about itself with them. The Python script used for this introduction can be found in Appendix C1.

Chapter 6: Field trial

After the overview of robot characteristics, this chapter will explain the field study in more detail. The goal of the field study was to measure the responses of the children and their parents to the different robot characteristics.

6.1 Method

The field study was chosen as a method to let children in the target group experience an interaction with the robot. We performed a field study to collect data in a natural environment.

6.1.1 Participants

Eight children participated in the field study. Four were male, four were female and the mean age was 8.9 years (*SD* = 1,7 years). The age range was 7 – 11 years old. All children were diagnosed with T1DM within the past 3 years. This was deliberately chosen, because these children still lively remember the period of hospitalization directly after the diagnosis. The children were patients from two different hospitals. All participants received a small gift for their participation: a mug with the logo of Gelderse Vallei Hospital and biscuits.

6.1.2 Materials

The NAO robot was used to interactively play a trivia quiz with the children, using a tablet on a see-saw, positioned between the robot and the child. The questions were both diabetes and non-diabetes related (see Appendix D). The interaction was videotaped using a camera.

Children received a questionnaire about the robot characteristics, using two different rows of smileys to depict the levels of a 5-point Likert scale (see Appendix E). In Figure 9 and Figure 10 these smileys are shown. The smileys in Figure 9 were used for questions that asked for their opinion and the smileys in Figure 10 were used for questions that could be answered with yes or no. Examples of these questions are: 'What do you think of the movements of the robot?' and 'Do you want to be friends with the robot?'. Answers of children on the 5-point Likert scale were converted to numbers, ranging from 1 for the least happy smiley to 5 for the happiest smiley.

Fig. 9: 5-point Likert scale depicted by smileys

Fig. 10: 3-point Likert scale depicted by smileys

The parent(s) of the children were interviewed with questions about each characteristic (see Appendix F). Examples of interview questions were 'Is it important that the robot shows gestures during the interaction? Why do you think that?' and 'Is it important that the robot makes eye contact with a child? Why do you think that?'.

6.1.3 Procedure

The researcher visited the participants at their homes, with the NAO-robot. After explaining the research and letting the parent and the child sign the informed consent form, the interaction started. The child was positioned in front of the robot and was sitting on the ground, see Figure 11. The robot first introduced itself to the child and asked the child some personal questions. Next, it explained the rules of the trivia game and the game started. The parent(s) of the participant watched the interaction and the interaction was recorded on camera. After the interaction, the children received a paper questionnaire on paper and the parents were interviewed by the researcher. Afterwards, the children received the gift, and the children and their parents were thanked for their participation.

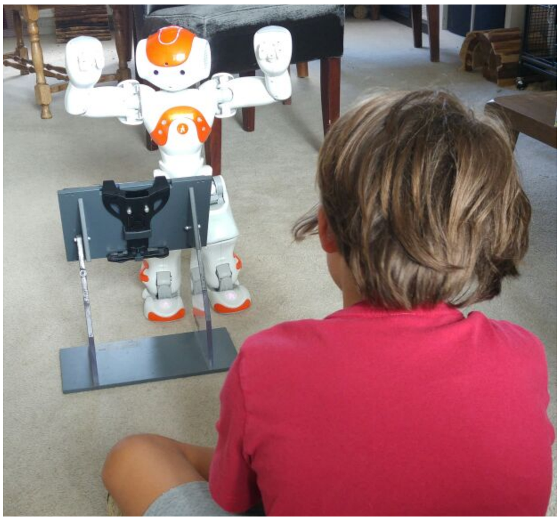

Fig. 11: Set-up of the experiment, with a child and the robot. The robot performs a cheering motion.

6.2 Results

To combine the data collected from the videos, from the interviews with parents and from questionnaires for children we performed a thematic analysis (Braun & Clarke, 2006). In this section, the different results are discussed. Two main methods were used to get the results: The first one was looking for a pattern in the video data, and confirming these results in the interview data and/or questionnaires. In the second one we looked for a pattern in the interview data and confirmed these results in the video data and/or questionnaires.

All data consisted of eight interviews with parents, eight questionnaires filled in by children and seven videos of the interactions. The camera failed in one interaction, so not all eight interactions were videotaped. One child was afraid of the robot, which resulted in his mother doing the interaction with the child sitting beside her. The data obtained from this child and its parent is considered an outlier.

In this section, an overview of four categories of findings are presented. In any quotes that are used, the names of the children are fictitious.

6.2.1 Reactions on movements of the robot

To be able to summarize the results on the reactions on movements of the robot, we formulated a hypothesis based on what we find in the data and tested this hypothesis against the data. Where needed, we refine the hypothesis based on what we find, and end with a final hypothesis. This strategy is based on Braun & Clarke (2006). For this finding, we ended with this hypothesis: when the robot performs a movement other than flipping the tablet, the child almost always gives a positive reaction, because they like it, mainly the positive movements. In this section, we explain how we get to this hypothesis.

After a first inspection of the video recordings, it appeared that children responded to the robot's movements. To refine this finding, a closer look was taken into the interview data and the questionnaires.

All parents considered gestures to be important during the interaction. The reason for this perceived importance can be divided in three main patterns. Some parents considered gestures to be important because it adds to the personality of the robot:

'According to me, this shows that the robot is a person. It is as if there is another child sitting in front of them. It is not only a computer or an iPad'

'I think it contributes to it being someone'.

Other parents mentioned that gestures help making contact to the robot and the rest of the parents thought gestures added to game experience:

'Certainly for children, it is more fun when something moves.'

In the questionnaire data, children responded positively on the movements of the robot on the 5-point Likert Scale (M = 4.38; SD = 0.74). Combining the interview, the questionnaire and the video data, we added "because they like it" to our hypothesis.

In order to validate the current hypothesis, we returned to the video data. We focused on all specific movements of the robot: cheering, looking sad, thinking, and flipping the tablet. In the cases of cheering, looking sad and flipping the tablet, we made sub-divisions. Because the robot shows an emotion irrespective of the one who answers a question, cheering was sub-divided in "Robot answers correctly" and "Child answers correctly" and looking sad was sub-divided in "Robot answers incorrectly" and "Child answers incorrectly". Flipping the tablet was subdivided in "success" and "fail", based on whether the robot managed to flip the tablet.

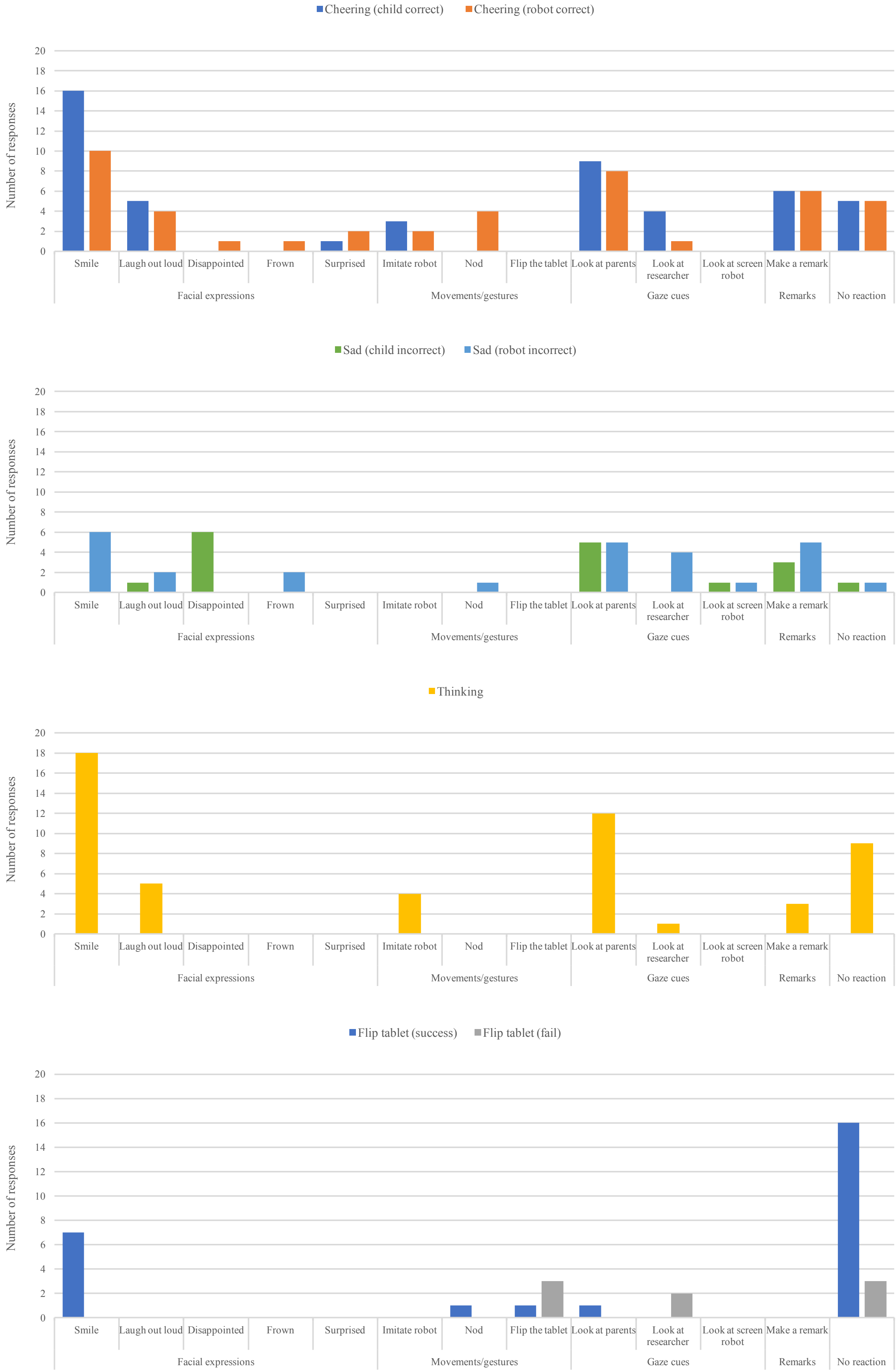

Fig. 12: Number of reactions of children on movements of the robot

After specifying the movements, the responses or non-responses from all the children after each movement of the robot during the interaction were counted. In 74,5% of the cases where the robot made any movement, the child reacted. When we leave out the scared participant (outlier) in this analysis, who only reacted in 14,5% of the cases, this percentage becomes 82,1%.

All the observed responses to movements of the robot are displayed in Figure 12. It is noted, that after each movement of the robot, the children often gave a reaction. The exception to this rule is flip the tablet (Figure 12d). Therefore, we specified the type of movements a child reacts to in our hypothesis.

To check whether this new hypothesis holds, we considered the type of reactions given by the child. We noticed that cheering (Figure 12a) and thinking (Figure 12b) gave the most positive reactions, such as smiling and laughing, or imitating the robot. These movements seem to be experienced as more positive than the sad movement. Because of this finding, we arrive at our final hypothesis: when the robot performs a movement other than flipping the tablet, the child almost always gives a positive reaction, because they like it, mainly the positive movements.

If the children like the movements of the robot, it would make sense if they all had chosen the first or second smiley when asked about their opinion on the movements of the robot. Four children choose the first smiley, three the second and one chose the third smiley. We looked back in the video data to explain the children that did not chose the first smiley. The child that selected the third smiley was the scared child, who did not follow the general pattern. However, while he only chose third, fourth or fifth level smileys, movements were still evaluated more positive compared to other characteristics. The video data of the three children that selected the second smiley is consistent with the final hypothesis. They react when the robot moves. However, two of these children smile throughout the whole interaction and the third child showed signs of puberty and was clearly trying to strike an attitude throughout the interaction.

6.2.2 Trivia game

The second result that is discussed focuses on the trivia game. We again used the method in which we formulate a hypothesis and rephrase this hypothesis by checking it in our data (Braun & Clarke, 2006). We arrived at the following hypothesis: after a short period of getting used to the game, all children get engaged in the game, and some children get competitive.

We started with watching the video data. All seven participants on video appeared to get engaged in the game. The engagement of the children was expressed in different ways: they commented verbally on questions (*'this was such an easy question'*), cheered when their answer was correct, or gave non-verbal feedback to the robot's answers by shaking their head or nodding. With most participants, this did not start until after a few questions. We expected that all children get engaged in the game after a short period of getting used to it.

Looking at the videos, we noticed that some participants became competitive during the game. There were no scores or competitive elements in the game, but still some participants wanted to answer more questions correctly than the robot. This effect was observed mainly in two of our participants, both boys. One of these boys cheered when the robot answered a question incorrectly and was disappointed when it answered the next question correctly (*'I hoped it was wrong'*). The other boy shouted *'Yes'* when the robot answered the question incorrectly.

We checked these findings with the questionnaire. The children tended to like it when the robot gave incorrect answers (M = 3,9; SD = 1,4). Because one child that circled the third smiley still seemed to be competitive (cheering when the robot answered incorrectly), we checked for explanations to the given answer in the interview data with his parents. His parents appreciated it when the robot answered incorrectly:

'Yes, you could see it at the behaviour of Samuel. He was happy when the robot answered the question incorrectly.'

Because of this quote of his parents and the observed behaviour of the child, we assume that this child misinterpreted the question in the questionnaire.

The interview data from other parents show similar results. All the parents thought that answering questions incorrectly was an important feature of the robot. Some of them thought it was important because children make mistakes as well:

'Yes, because then a child knows that they are allowed to make mistakes'

'Yes, because otherwise a child will get the feeling that they have to do it right all the time.'

Other parents thought that making mistakes added to the personality and human-likeness of the robot:

'If a child makes a mistake and the robots makes a mistake, that gives them human-like aspect.'

'I think it is important as well, because otherwise it is stressed that it is a robot. A computer does everything perfect as well.'

With this information, we arrive at our final hypothesis: after a short period of getting used to the game, all children get engaged in the game, and some children get competitive.

6.2.3 Bonding

Bonding with the robot was a common theme in the interview data. Two questions in the interview script specifically addressed this theme ('Do you think your child can become friends with the robot?; What do you think about children becoming friends with the robot?), but apart from these questions the topic of bonding regularly emerged in all the interview data. In this section the references to bonding are summarized and categorized.

All parents thought that it was important that the robot showed emotions. When they were asked why they thought showing emotions was important, five of the eight parents mentioned the aspect of bonding. Some of the things they mentioned were:

'That is when you slowly get into the game with each other. If it stays an object it is hard to really form a bond or a relationship I think. So, I think emotions are important for the thing you want to do.'

'[Emotions are important] to make contact, that is when you get the idea you are in contact with a person'

'Yes, and the interactive character increases. That is when you are in contact with him'.

The parents were also asked about the importance of the robot attempting to match the emotions of the child: happy when the child answers a question correctly and sad when a child answers a question incorrectly. Again, they all considered this characteristic to be important and some of them mentioned that it contributed to bonding:

'Isn't that the basis on which you maintain the contact between each other? If that is gone, a child does not feel any reason to do good, or answer correctly.'.

Another characteristic that contributed to bonding, according to some parents, was the memory of the robot. The parents were asked what they thought of the idea that the robot remembers the interaction with their child and one parent commented:

'I think that is perfect. Children will have the idea they have a buddy.'

The next recurring theme that was considered to contribute to bonding was the personality or human-likeness of the robot. Comments related to this theme are:

'I think that all mannerisms that come close to human behaviour help to create sympathy and to build a sort of relationship'

'Yes, to seek rapprochement, it has to be a sort of human-like robot, I think. Otherwise, you will never reach rapprochement.'.

To find the opinion of the parents about bonding, we investigated and compared the two questions that directly asked if their child could form a friendship with the robot, and what they thought about that. Five parents answered with a full yes to the first question. Most of them thought it was entertaining and fun for the children:

'I think it is really appealing to children and really fun.'

'Yes, I think he has already built a relationship!'

The other three parents were a bit more sceptical, but still thought it was (partially) possible. They used terms as *'Yes, sort of'* or *'Yes, to a certain extent'*. One parent indicated:

'I think friendship is too much, but it is nice to have contact with the robot.

As to why a robotic friendship is important, most parents valued the entertaining aspect of having a robotic friend:

'That would be fun of course'

'In the period of hospitalization Samuel was sometimes whining that he was bored and that there was nothing to do, expect playing on his phone. I think it would be nice if there was a robot to have an interaction with.'

Several parents who could see the benefits, but also some possible downsides of having a robot friend:

'It is all right with me, as long as it does not take too much time.'

'I don't think it can hurt. If she cannot find a man later, because she is detached and can only fall in love with robots, but we do not know that. We have to see how develops.'

Some parents had problems with the word "friendship", and would rather rephrase the term:

'What is friendship? After 5 days in the hospital you have to say goodbye and you will never see him again. Is that a friend? I think it depends on the word "friend". Maybe you would have to limit it and call it "your friend in the hospital". I do not think it is a friendship for life.'

'It would be nice to have someone who knows a lot about diabetes and can react on that, but than it is more like a coach and not a friend. I am looking for another term'.

The mother that was quoted last mentioned when the researcher was about to leave that she did agree with calling the robot a *'buddy'*.

Only one parent did not agree with children becoming friends with the robot:

'If the goal is to build a relationship, I really think that should happen between humans. This stays a robot. [...] I can see the goal of stimulating a child to express themselves, but not a goal of building a relationship. But it might be that you need to build a relationship before children can express themselves.'.

We also checked the opinion of the children in their questionnaire. When asked if they wanted to be friends with the robot, children could answer by circling smileys as in Figure 10. Six children chose the first smiley and two circled the last smiley. One of them was the child who was scared of the robot, and the other child was in a bad mood during the interaction, and was reprimanded by his parents at the start of the interaction, because he did not answer the questions of the robot truthfully (Robot: *'How old are you?'* Child: *'250'*).

During the interviews with her parents, one girl said the following about the interaction with the robot:

'I think that if someone has to stay in the hospital with diabetes for many days, it would be nice to have a buddy. I stayed in the hospital for 1 or 2 nights, but I think that especially when you have to stay for a week, it would be nice. It is easier to tell things to a buddy than to a doctor.'

6.2.4 Gazing

The last characteristic that we analysed is the gazing behaviour of the robot. Since the robot used the *autonomous life* module as explained in Chapter 5, with some additional gaze cues, we were not completely sure in which direction the robot would look mostly during the interaction. To check this, we asked the parents: 'What do you think the robot looked at most during the interaction?'. Six parents answered that the robot mostly looked at their child:

'I think to Daniel, or at least in that direction.'

The other two parents did not know where the robot gazed mostly:

'I don't know, he looked around for a bit. [turns to child] *Did it look at you as well? I don't really know.'*

'I didn't really focus on that.'

We also checked the video recordings. In all the interactions, the robot made eye contact with the child, looked at the tablet, and looked around, as planned. However, in two interactions the robot turned its head to extremes both left and right. This seemed to be a technical error. In both cases, the child did not give a reaction to these strange head movements.

The parents were asked if they thought that making eye contact is important. Five parents thought that eye contact was positive and important:

'*Yes, it is nice when you talk with somebody to have eye contact.'*

'Yes, the robot looks like a human and that is why eye contact is important.'

Three parents were not sure and thought that making eye contact was also a little bit scary:

'Maybe when you are scared of the robot, it can be scary.'

'I don't know. Daniel wrote that he thought it was scary if the robot looked at him. I think it is important that the robot looks in the right direction. Not that the robot looks up while my son is sitting right in front of him. But maybe eye contact is less important.'

We looked in the questionnaires to see what the children thought of eye contact. The opinions were divided. The parents of two children indicated in their interviews that eye contact might be scary. Overall, this question provides for the lowest average score across all the questions that were answered on a 5-point Likert Scale in the questionnaire (M = 3,5; SD = 1,7).

Considering the gazing behaviour in general, all parents indicated in their interviews that the gazing of the robot looked natural:

'I had the idea that he really looked around, I thought that felt rather natural.'

'Yes, just as I mentioned in the beginning. I thought it was natural that after he stood up he immediately explored the room. He looked where he was and who were there.'

All parents further indicated that they thought this was important:

'If you want to imitate being as comfortable as when you are with a human, I think it is important.'

6.3 Discussion

In the field study, several sources of data were collected and analysed: video data, interview data and questionnaires. In this section the results of this field study are discussed in the same order as they were presented.

6.3.1 Reactions on movements of the robot

Children appeared to be entertained by the movements of the robot. However, we need to consider that when the robot performed a movement there was a game element related to it. Cheering could mean that either the child or the robot answered a question correctly. The reactions that were seen in the videos could be interpreted as reactions to this game element, and not to the movement of the robot. However, from the combined data we found that movements of the robot are still experienced as entertaining.

6.3.2 Trivia game

After a short period of getting used to it, all children got engaged in the game and some children became competitive. In our data, only boys got competitive. Although we only had a limited number of participants, our data seem to suggest that it could be beneficial to add an extra competitive element in the game, at least for boys.

In an study by Gneezy & Rustichini (2004) it was found that boys benefit more from a competitive environment, more than girls. This finding supports our results and this means that whenever the interaction with the robot will be personalized, the gender of the child matters.

6.3.3 Bonding

There were several findings related to bonding between robot and child. Most parents thought that showing emotions contributed to bonding. Another finding was that some parents considered the human-likeness and personality of the robot to contribute to bonding. This suggests that it is important to implement emotions and personality characteristics in the robot for establishing a bond between robot and child.

Some parents considered the possibility of a friendship between their child and the robot to be entertaining, others had some concerns. A few parents did not like the word “friend” and would rather use another word, such as “buddy”. Only one parent rejected the idea of children befriending robots. Most children indicated they would want to be friends with the robot. In the current context, this means that children and parents are open to bonding. This gives promising results for long-term interactions.

6.3.4 Gazing

The main finding on gazing is that some children indicate that they do not like it when the robot attempts to make eye-contact with them. However, not all children and parents relate to this finding, so this problem with eye-contact differs between children. If a child indicates that eye-contact is scary, it could be beneficial to program the robot in a way that it makes less eye-contact. Possible solutions are to diminish the frequency of eye contact overall, or adapt the frequency of eye contact using facial expression recognition. Whenever a child looks scared, the robot could look away.

6.3.5 Limitations and future research

For this research, we choose to give the children questionnaires and interview the parents, because parents can easier understand all different robot characteristics. However, during some visits we found that (mainly the older) children also say some interesting things about the robot. In a future research, interviewing the children could provide more detailed results than giving them a questionnaire.

Another aspect that can be improved in this research is measuring the long-term effect of the interaction with the robot. When the robot is used during the period of hospitalization, the children will meet the robot daily during 4 to 5 days. The effects we found may change in a long-term scenario, because the novelty of the robot wears off after some time. As a result, their attention span for the robot might reduce. To study long-term effects, the duration of the field trial needs to be much longer.

The participants in this study were all diagnosed with diabetes within the last 3 years. Such a period may still be a long time ago for a child of 7 years old and it may be hard to remember how the period of hospitalization was. Therefore, we recommend for future research to test the robot with children that are diagnosed very recently, during their period of hospitalization. These children may experience the robot differently, given their current situation.

Chapter 7: General discussion

The current research was designed to find out how a social robot can have a positive influence when interacting with children with Type 1 Diabetes. Children between the ages of 7-12 with diabetes need to take responsibility over the tasks managing their disease. During the period of hospitalization right after their diagnosis, a social robot could support them emotionally and support them in learning self-management. In this research the following research question was investigated: how can a social robot effectively have a positive contribution to the education process during the period of hospitalization directly after diagnosis?

Following an extensive literature study, we composed a set of different characteristics of a social robot that have a positive effect on the interaction with a human. We focused on emotions, movements, gazing behaviour, intelligence, personality, role-switching, memory and self-disclosure. We expected that the results of this study could give insights in the importance of these different characteristics within the current context.

Using an online questionnaire, we established about the perceived importance of the robot characteristics in the current context and about their perceptions of robots in general. In the field trial, we visited children with diabetes at their homes to let them interact with the robot that supported these characteristics. We evaluated the interaction based on the video recordings, questionnaires and interviews with the children's parents.

7.1 Movements of the robot

We found that the various movements of the robot contributed positively to the experienced quality of interaction. In the online questionnaire, in general children indicated that they liked it when the robot moved, and parents indicated that they thought it was important that the robot uses gestures and is not immobile during an interaction. In the field study, we observed that children reacted to the robot's movements by making verbal comments and showing non-verbal reactions, like smiling or imitating the robot. Also, parents indicated in the interviews that the robot's movements in general were entertaining, added to the personality of the robot, helped making contact and added to the entertaining aspect of the trivia game.

One of the differences between a social robot and a doll or plush animal is the animacy of the robot. This contains the gesticulation of the robot. People who are not used to interacting with robots can be surprised by the way it moves and therefore like it. If this explanation holds, it would mean that the entertainment factor of movements will diminish after several interactions, because children get used to the robot and to its movements. This effect is known as the novelty effect.

Another possible explanation of this finding is that the movements of the robots match the expectations of the person interacting with it. The physical appearance of a robot can influence the expectation people have of this robot (Powers & Kiesler, 2006). Because the robot has a humanoid shape (head, arms and legs) people can expect that the robot can make human-like movements. When the robot fulfils these expectations, this is evaluated positively.

This explanation matches with the opinions of the parents who indicated in the interview that the movements made the robot more human-like and shaped its personality.

7.2 Emotions and bonding

In the online questionnaire parents thought it was important that the robot showed emotions. However, they were not sure whether the robot was capable of showing emotions. However, their combined answers to the questions about robots in general, revealed that they did not have much experience with social robots. This could possibly explain why they thought a robot was not capable of showing emotions. All parents that saw the social robot in the field study acknowledged the emotional cues that the robot showed. When they were asked if the robot showed emotions, they all answered positively.

After the field study, some parents linked the display of emotions by the robot to bonding between the child and the robot. In their opinion the bond between the child and the robot was established, because the robot showed emotions and empathy. In an interaction between humans, expressive behaviour contributes to forming a social relationship with your interaction partner (Butler et al., 2003). Apparently, this finding is replicated in the observed interaction between the robot and child, according to several parents.

Not only emotions were linked to bonding, but some parents mentioned that the memory of previous interactions and the personality of the robot also contributed to bonding. Both these aspects are related to friendship in humans as well. Remembering interactions and personalities can also be considered to contribute to forming a friendship between humans.

Parents and children seemed to support the idea of a bond between the robot and child. In the online questionnaire parents were not positive or negative about bonding and children were quite positive. In the field study, most parents and children were positive about bonding, but some parents wanted to call the robot a *buddy* rather than a *friend*. The difference could be found in the assigned emotional value. Some people might assign more emotional value to the word *friend*, as friendship between humans can be very important within a person's life. Friendship between humans and robots is still a relatively new concept in our society and can be considered to have a different meaning to a person than friendship between humans, so it makes sense that people want to give it a different name to explain it.

Bonding between the robot and the child can be helpful in several different ways. Children with diabetes are positive about having a friend with whom they can talk about diabetes (Blanson Henkemans et al., 2012). Secondly, when the robot and the child have a bond, the support for self-management can be more effective (Looije, Neerinckx, Peters, & Blanson Henkemans, 2016).

7.3 Eye contact

In the online questionnaire, both parents and children were positive about the robot making eye contact. However, in the field study, several parents and children indicated that the robot trying to make eye contact could also be perceived a little scary. Research in human-robot interaction often highlights the importance of making eye contact (Duffy, 2003). However, the results of the current study indicate that eye-contact can also have negative effects.

In human-human interaction eye contact does not always have to be positive. Continuous gaze is associated with dominance and power (Kleinke, 1986). It is possible that also some of the children in the current study associated the gaze of the robot with dominance. However, this seems to be an individual aspect, so it probably depends on the personality of the child whether eye-contact is perceived to be positive or negative.

7.4 Personalization

The last result that we discuss is personalization. Not surprisingly: the preferences of participants differed, both in the online questionnaire and in the field study. This suggests that whenever the robot will be used in the hospital context, it needs to adapt to the personality preferences of the user. Additionally, Looije et al. (2016) suggested that in order to learn self-management, the strategies also need to be personalized.

In the current study we did not implement personalization, but our results suggest that this is important. Examples of possible adaptations considering personalization are: the level of competition in the game that is played, the frequency of making eye contact, and the personality of the robot.

7.5 Limitations and future research

The participants in this study never experienced a social robot before, so it is difficult to say whether our results also apply to long-term interactions. It could be that the interest in the robot wears off quickly (Leite et al., 2013). In our scenario, the interaction with the robot only lasts several days, so the novelty effect is probably not that much of a problem. Still, it would be useful to play the trivia game with different questions every time, to prevent loss of interest.

It could also be beneficial to test this interaction in hospital context. The current study took place at the homes of the children, but the robot will eventually be used in the hospital. It would also be good to test the interaction with children that are more recently diagnosed. The ecological validity of the current study was already quite high, but it still has some differences with the final application, so testing in the hospital with recently diagnosed children could be relevant.

7.6 Conclusions

We found that the robot’s movements provide for entertainment, that emotional expressions contribute to bonding, eye contact is considered to be mostly positive, but can be perceived as scary and it is important that the behaviour of the robot is personalized. These findings support our supposition: if the robot shows movements and emotional expressions, there is a bigger chance that the children like the robot and bond with it. Therefore, the positive contribution of the robot can be larger. Furthermore, if the robot adapts to the user, the contribution will be even more positive and effective.

We implemented a number of robot characteristics and found that movements and emotional expressions were evaluated positively by children with diabetes and their parents. This validates the use of these characteristics for educating children about diabetes in their first week of hospitalization. The response of the children and parents to eye contact were mixed, showing that they are person dependent and need to be made adaptive. Therefore, we recommend the hospital to include movements and emotional expressions in the final design of the robot. We furthermore recommend them to personalize the robot to the individual user.

These findings and recommendations are not only interesting in the context of children diagnosed with diabetes type 1, but can also contribute to the generic field of social robotics. The insights given by the current research on what characteristics of the robot influence the interaction, can to some extent be generalized within other applications of social robots. With these results, we are one step closer to effectively use social robots within the domain of healthcare & therapy and beyond.

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Appendix

Appendix A – Interview paediatric diabetes nurse

This is the transcript of the interview (in Dutch) held with a paediatric diabetes nurse of Gelderse Vallei Hospital on April 14, 2017. The goal of the interview was getting a clear idea of the situation of a child diagnosed with Type 1 Diabetes.

Diagnose

Het doel van dit gesprek is duidelijkheid over periode van opname na diagnose. De vragen die ik ga stellen zijn onderverdeeld in vier categorieën. Laten we beginnen met de diagnose. Hoe verloopt de diagnose? Wanneer komt een kind binnen in het ziekenhuis?
Een kind gaat in eerste instantie naar de huisarts, met de klachten veel drinken en veel plassen. Bij de huisarts wordt vaak al een eerste bloedsuiker geprikt. Als deze te hoog is, wordt het kind hier doorverwezen naar de spoedpoli. Dan komen ze op dezelfde dag hier op de poli terecht.

Blijft een kind meteen in het ziekenhuis?
Ja, ze worden gelijk opgenomen. Nadat ze op de poli gezien zien wordt er nog even bloed geprikt en dan gaan ze naar de kinderafdeling om te worden opgenomen. Als kinderen uit een gezin komen waar er al meerdere zijn met diabetes, maar eigenlijk nemen we ook die toch nog even kort op.

Is dat omdat de ouders van dat gezin al meer informatie hebben over diabetes?
Ja.

Komt dat veel voor, patiënten uit hetzelfde gezin?
Niet zo heel vaak. We hebben een aantal gezinnen die wel meerdere kinderen hebben met diabetes, maar dat is toeval.

Waar blijven de ouders en andere kinderen uit het gezin na het moment van opname?
Ze komen vaak met 1 of 2 ouders, en die ouders die mogen 24 uur per dag bij hun kind zijn. Het is afhankelijk van de leeftijd of een ouder blijft slapen. Broertjes en zusjes mogen er altijd gewoon bij zijn.

Wanneer zien ze jullie, de verpleegkundigen, voor het eerst?
Soms zien ze ons al heel even op de kinderpoli, dan worden we er even bij geroepen om kennis te maken. Meestal zien ze ons dezelfde dag even op de kinderafdeling, dan lopen we even langs en maken we kennis en dan maken we een afspraak voor de volgende dag. Als dat niet lukt dan komen we in ieder geval de volgende werkdag komen we bij de kinderen en hun ouders langs.

De kinderen hebben een hoge bloedsuiker en last dorst en veel plassen. Voelen de kinderen zich ziek als ze hier komen?
Dat ligt er een beetje aan.

Hoe snel voelen ze zich dan weer wat beter?
Als kinderen echt heel ziek zijn en helemaal ontregeld zijn zodat ze ook aan een infuus moeten dan duurt het echt wel een paar dagen voordat deze kinderen opgeknapt zijn. Maar als ze hier gewoon komen met de diagnose veel drinken en veel plassen en ze zitten er nog goed bij, dan merk je echt wel na een paar dagen wanneer ze begonnen zijn met de insuline dat ze zich al beter voelen.

Hoeveel dagen na opname start de educatie?
De educatie begint nooit op de dag van diagnose, want dat heeft namelijk geen zin. Als je die dag de ouders en kinderen al heel veel gaat vertellen zijn ze het echt de volgende dag al weer vergeten. Daarom starten we de volgende dag met de educatie. Dat gaat stapsgewijs. We gaan ze niet meteen

heel veel vertellen, we beginnen gewoon met een half uur tot een uur, en we beginnen gewoon met de basiseducatie. Dat wordt dan de rest van de week uitgebreid.

Educatie

Hoe verloopt een dag waarop kinderen en ouders les krijgen?
Wij spreken een tijdstip af en we vragen altijd of beide ouders erbij kunnen zijn. Wij komen gewoon langs, dan beginnen we gewoon met de educatie, daarnaast krijgen ze ook begeleiding van de kinderafdeling. De verpleegkundigen doen natuurlijk al gewoon bij de maaltijden bloedsuiker prikken en insuline spuiten. De pedagogisch medewerkers maken ook vaak een dagprogramma en gaan ook sporten met de kinderen. Het is niet zo dat wij daar 8 uur lang alleen maar educatie geven, ze hebben ook wel tijd en ruimte voor hunzelf.

Dus er zijn van allerlei aspecten in zo'n dag. Zien ze ook meteen een diëtist?
De diëtiste, maatschappelijk werken en psychologe komen allemaal in consult. Psychologie loopt nooit gelijk langs, dat is altijd pas na een paar weken. Tenzij wij een psychologisch probleem zien, dan natuurlijk wel. De diëtiste proberen we altijd wel zo snel mogelijk bij de ouders en de kinderen langs te laten gaan. De maatschappelijk werker loopt gedurende de opname ook altijd even binnen voor een gesprek.

Is dit per leeftijdscategorie anders en zo ja, hoe zijn deze leeftijdscategorieën dan ingedeeld?
Je hebt de jonge kinderen van 0-6 jaar. Daarna heb je de basisschoolkinderen, die je eigenlijk ook weer kunt onderverdelen in twee groepen: kinderen van 6-9 jaar en kinderen van 9-12 jaar en dan heb je wel de tieners. Bij de jonge kinderen is de educatie eigenlijk alleen maar voor de ouders. Als ze iets ouder zijn zitten ze er vaak wel bij en onthouden ze heel veel. Vanaf een jaar of 8 kun je kinderen wel meenemen in de educatie.

Wordt er tijdens de educatie rekening gehouden met de cultuur van het gezin?
Ja dat proberen we wel zoveel mogelijk. Wat we altijd doen is dat we de diabetes aanpassen op de situatie van het kind, en niet het kind op de diabetes. Dus we houden altijd rekening met achtergronden, leefstijl, gewoontes.

Hoe kun je daar dan rekening mee houden?
We kijken met de ouders samen wat bij het kind past en wat haalbaar is.

Is er een groot verschil tussen jongens en meisjes?
Nee, dat valt op zich wel mee. Meisjes zijn vaak wat serieuzer, maar op zich maakt dat niet zo heel veel uit. Het is wel zo dat het ene kind van 7 sneller dingen onthoudt dan het andere kind van 7 en dat verschil heb je ook tussen de 9 en 10 jaar. Dus je moet vooral echt heel goed kijken naar het kind. Wat kan een kind aan en wat nog niet?

Hoe wordt er rekening gehouden met co-mobiliteit?
Waar je wel heel erg naar moet kijken is kinderen met autisme, met PDD-NOS. Hoe behandel je die en hoe ga je daarmee om? Wat ik zelf vaak doe is even met de ouders checken van wat past gewoon bij het kind. We hebben ook één jongen met het syndroom van Down, daar ga je natuurlijk wel anders mee om, dan doe je veel meer zaken met ouders. Ik belde vanmiddag nog met een moeder, die hebben een heel gehandicapt kind, dus daar kijk je wel naar.

Dus de periode is wel altijd persoonlijk?
Wat ik echt probeer in de eerste week is een band met de ouders op te bouwen en in de eerste afspraak probeer ik ook altijd het gezin een beetje te leren kennen. Zodat ik weet of ze nog broers en zussen hebben, wat voor werk de ouders doen, op wat voor school zit een kind, wat voor hobby's heeft het kind, dat soort dingen probeer ik altijd wel een beetje te achterhalen.

Evaluatie

Wie bepaalt er of het kind en ouders klaar zijn met de educatie?
Wij, de verpleegkundigen.

Wanneer gebeurt dat?
Dat is een beetje afhankelijk, we zeggen meestal tegen ouders, reken maar op een dag of 5, 6 of 7, een kleine week. Je hebt ook ouders en kinderen die met 3 of 4 dagen het allemaal weten en zelf kunnen doen en dan doe je de evaluatie en pak je het hier op de polikliniek verder op, maar je hebt ook ouders die iets meer de tijd nodig hebben en dan pak je gewoon iets langer.

Dan volgt er dus een eindgesprek voor de evaluatie. Wie zijn er allemaal bij dit eindgesprek aanwezig?
In principe doen wij dat. Wij doen altijd in ieder geval een eindgesprek en wat ik zelf bij dit eindgesprek doe is: ze krijgen altijd een infomap, als ze starten met de opname en daar zit een checklist in, en die loop ik altijd met ouders even door om te kijken of ze daar vragen over hebben. Dat is voor mij ook even een checklistje om te kijken of ze het hebben begrepen of dat moet ik nog even een keer extra uitleggen.

Is het zo dat je pas als je zelf inschat dat ze ook alles weten van wat er op de checklist staat dat je het gesprek aangaat?
Ja, als ik bijvoorbeeld op dinsdag weet van het spuiten doen ze zelf, dit weten ze allemaal dan zeg ik tegen ze: misschien kunnen we morgen het laatste gesprek plannen en kunnen jullie daarna naar huis en eigenlijk kan dat dan ook altijd wel.

Dus het nooit zo dat je dan na een gesprek toch zegt dat ze nog een dagje langer moeten blijven?
Nee, dat zou ook wel heel vervelend zijn.

Wat is de rol van de ouders tijdens dit gesprek?
Dat is ook wel afhankelijk van het kind. Bij een tiener zou ik zelf eerder de vraag aan de tiener stellen en kijken of die zelf het antwoord kan geven, aangevuld door pa en ma. Als het een jong kind is, moet je het echt allemaal met ouders doen en dan hoor je zo tussen neus en lippen door wel wat een kind zelf al weet, dat zie je eigenlijk altijd wel gauw genoeg al.

Dus bij de jongere kinderen is het zo dat je eigenlijk vooral de ouders test op hun kennis.
Ja

Zijn allebei de ouders hierbij aanwezig?
Het liefst wel, maar goed, vaders zijn vaak nogal druk en kunnen weinig vrij krijgen van werk, dus dan moet je het alleen met moeder doen. Het streven is wel dat bij ieder gesprek dat plaats vindt dat daar wel ouders bij zijn. En ik moet zeggen dat dat eigenlijk ook wel gebeurt hoor. Ouders die een eigen zaak hebben, of waarbij het wat lastig is, hierbij is het toch wel vaak de moeder die dan aanwezig is.

Wat vind je belangrijk dat de kinderen van de bovenbouw uit de basisschool, ongeveer 8 – 12 jaar, zelf al kennen tijdens het evaluatiegesprek?
8 en 9-jarigen hoeven van mij nog niet zelf te kunnen spuiten, dat kan altijd nog wel later, maar ik vind het wel belangrijk dat ze kunnen zeggen wat diabetes is. Ik zeg ook altijd, je gaat terug naar school en iemand vraagt aan jou wat is diabetes, kun je dat dan ook uitleggen? Ook wil ik dat ze in ieder geval weten wat ze moeten doen bij een hoge bloedsuiker en lage bloedsuiker en dan is een lage bloedsuiker nog het belangrijkste, zodat ze weten wat ze moeten doen bij een hypo.

Ook het herkennen van symptomen?
Zeker, maar dat is vaak wel lastig. Want ze zitten dan op de afdeling en dan zitten ze eigenlijk altijd nog wel hoog. We laten de kinderen ook altijd naar huis gaan, ook al zitten ze nog hoog in de bloedsuiker, omdat de instelling thuis gewoon het snelste komt. Dus ze hebben nog niet altijd een hypo gehad, dat maakt het wel lastig.

Zijn de symptomen per persoon verschillend?
Ja, maar ik zeg altijd tegen kinderen, luister maar gewoon heel goed naar je eigen lichaam. Voelt er iets anders dan anders, dan moet je gewoon even meten, want meten is weten. Maar ik vind het belangrijk dat ze weten wat ze hebben en wat doe je bij een hypo en de rest komt dan altijd later pas, of dat weten de ouders wel.

En voeding?
Dat doet vooral de diëtiste, maar dat ze wel weten dat ze niet meer te pas en te onpas de snoeppot leeg kunnen eten, dat moeten ze wel even overleggen. Maar dat weten kinderen vaak wel heel snel.

Robot

Wat vind je tot nu toe van het inzetten van de robot, van wat je er al van gezien hebt?
We hebben er op zich niet zo heel veel van gezien. Ik heb een documentaire gezien en hier heel kort een beetje van het PAL-project gezien. Ik vind vooral de wisselwerking tussen de kinderen en de robot heel erg leuk. De kinderen zien hem ook inderdaad wel als een soort maatje, en het communiceert ook wel heel erg makkelijk. Het is voor mijn gevoel meer op het niveau van het kind. Wij zijn natuurlijk wat groter en we weten wat meer, maar als de robot op een tafel staat en het kind zit erachter, zit hij wel heel erg op het niveau van het kind. En de interactie met het kind vind ik wel heel erg leuk. Ik denk zeker dat het bij kan dragen.

Hoe zie jij zelf de rol van de robot in de periode van opname?
Dat vind ik best lastig. Het is heel saai als wij dat gesprek doen, kinderen zijn snel afgeleid en denken: ja het zal allemaal wel. Dus ik denk dat als je het in een soort quiz moment doet om kennisvragen te toetsen dat dat zeker wel bij kan dragen en dat dat ook een leuke afsluiting is van zo’n periode dat je onverwachts in het ziekenhuis komt en dat je in een keer vanalles moet kennen en moet leren.

En voorafgaand aan het evaluatiegesprek, zie je daar ook een rol voor de robot, dus gedurende de educatieweek of juist op momenten dat er geen educatie is?
Ja dat weet ik eigenlijk niet zo goed. Het zou mooi zijn als je hem kunt programmeren dat hij bijvoorbeeld filmpjes kan laten zien. Ik laat kinderen ook vaak het filmpje van Klokhuis zien en om dat samen met een robot te doen is dat natuurlijk echt wel heel leuk. Of als de robot op je kamer zou staan en je hebt op dat moment een vraag over diabetes die je eigenlijk zou willen stellen maar er is niemand dat je hem dan aan de robot kan stellen.

Zie je het zitten dat de robot een rol speelt in de opname periode?
Ja op zich wel, zolang hij mijn baan niet overneemt vind ik het prima. Ik denk wel dat het leuk is. Toevallig had ik vanmorgen een meisje op de poli die vroeg wanneer ze weer met de robot mocht spelen want dat vond ze heel erg leuk. Dus het draagt zeker wat bij.

Het idee waar ik nu mee speel is om de robot gedurende de periode al vaker terug te laten komen, zodat het kind een band aan kan gaan met de robot. Wat vind je daarvan?
Ik denk wel dat de robot vanaf dag 1 misschien al wel mee moet. Ik zie mezelf al met dat ding rondlopen.

Hoe zie je dat voor je?
Het gaat ons wel meer tijd kosten, maar goed, dat haal je ergens anders wel weer terug. Maar ik denk wel dat hij vanaf dag 1 al mee moet. Zodat kinderen kennis kunnen maken en kunnen vertellen waarom ze daar liggen, en misschien dat hij ook de volgende dag met het onderwerp waar je mee bezig bent, dat hij daar ook over kan vertellen, of dat wij het samen met de robot doen.

De onderwerpen waar je het over hebt, zijn die in een schema voorbereiden?
We hebben een checklist, die zal ik je meegeven. Maar het zit ook wel een beetje in ons hoofd, wij doen het natuurlijk al zo lang. Ik laat het gesprek ook vaak een beetje leiden door wat ouders vragen. En dan ga ik vaak die richting op.

Er is dus geen vaste volgorde van onderwerpen?
Nee, maar als ik voor de robot weet welk knopje ik in moet drukken voor een bepaald onderwerp, is het ook goed. Er zijn wel vaste onderwerpen, bijvoorbeeld het zelf controleren van de bloedsuiker, het insuline spuiten, hypo's etc. Als je daarna de robot kunt gebruiken om wat uit te leggen of al meteen een klein quizje te spelen, denk ik dat dat zinvol is.

Er is dus geen protocol? Staat er nog iets op papier?
Ja de checklist achterin het mapje en het formulier wat ik je mee zal geven. Je begint altijd met de oorzaak, het verschil tussen type 1 en type 2, etc. Complicaties begin ik niet gelijk over. En dan gaan we vaak naar zelf bloedsuikers meten, waar let je op, en daar komt insuline spuiten bij. Dit is de vaste volgorde, maar als iemand mij wat vraagt, leg ik dat wel eerder al uit. Daarnaast hebben we ook de thuissituatie. Ik bedenk me nu opeens dat je ook het kind aan de robot kan laten vertellen wat zijn thuissituatie is en ondertussen kun je dan meeschrijven. Dan start wel het contact al. Deze onderwerpen moeten behandeld worden.

Gebruik je deze lijst ook als indicatie voor wanneer het klaar is?
Ja als er bijna overal vinkjes staan, weet je dat het bijna klaar is en dan kunnen we het checken aan de hand van de checklist. Al moet ik eerlijk zeggen dat als Hennie [andere kinderdiabetesverpleegkundige] op vakantie is en ik ben alleen, dat ik dan de checklist helemaal niet gebruik, dan heb ik wel in mijn hoofd zitten waar ik ben.

Hebben jullie als je wel met z'n tweeën werkt contact over waar je bent?
Nee we laten alleen de checklist achter en soms schrijven we wel nog bij bijzonderheden iets op. En we kunnen altijd ook in het verpleegkundig dossier weten wat er besproken is.

Oké, ik denk dat het duidelijk is, bedankt.

Appendix B – Online questionnaires

These are the online questionnaires (in Dutch) that were sent through Google Forms to children with diabetes type 1 and their parents.

Appendix B1 – Online questionnaire parents

Hartelijk bedankt voor uw deelname aan dit onderzoek. De volgende pagina geeft u informatie over dit onderzoek. Voordat u aan de vragenlijst begint is het belangrijk dat u kennisneemt van de werkwijze die bij dit onderzoek gevolgd wordt en dat u instemt met vrijwillige deelname. Leest u deze pagina a.u.b. aandachtig door.

Het doel van dit onderzoek is om informatie te verzamelen voor het verbeteren van een robot die ondersteuning verleent aan kinderen met kortgeleden vastgestelde Diabetes Type 1.
Het onderzoek wordt uitgevoerd door Margot Neggers, student aan de Technische Universiteit Eindhoven onder supervisie van Gert Jan van der Burg, kinderarts van het kinderdiabetesteam van ZGV en van Raymond Cuijpers van de Human-Technology Interaction group.

Deze online vragenlijst vult u in via uw webbrowser. Er worden u een aantal uitspraken voorgelegd over robots, waarop u zo eerlijk mogelijk uw mening geeft.

Het onderzoek duurt ongeveer 5 minuten.

U bent geselecteerd omdat uw kind binnen onze doelgroep valt (8-12 jaar).

Dit onderzoek brengt geen risico's met zich mee, en ook geen nadelige bijwerkingen

Uw deelname is helemaal vrijwillig. U kunt zonder opgaaf van redenen weigeren om mee te doen aan het onderzoek en uw deelname op welk moment dan ook afbreken. Ook kunt u nog achteraf (binnen 24 uur) weigeren dat uw gegevens voor het onderzoek mogen worden gebruikt. Wanneer uw kind en u niet mee willen doen, of zich terugtrekken heeft dat geen nadelige gevolgen voor de behandeling of de contacten met het kinderdiabetesteam.

Wij delen geen persoonlijke informatie over u of uw kind met mensen of organisaties buiten het onderzoeksteam. De informatie die we met dit onderzoek verzamelen wordt gebruikt voor het schrijven van wetenschappelijke publicaties en wordt alleen op groepsniveau gerapporteerd. Alles gebeurt helemaal anoniem en niets kan naar u of uw kind herleid worden.

Als u nog verdere informatie wilt over dit onderzoek, dan kunt u zich wenden tot Margot Neggers (email: robotzgv@gmail.com, telefoonnummer: 0633677430)

Als u op de startknop drukt verklaart u dat u dit document heeft gelezen en begrepen. U stemt ermee in om vrijwillig deel te nemen aan dit onderzoek.

Toestemming: ik heb het document gelezen en stem ermee in om vrijwillig deel te nemen aan dit onderzoek.

Pagina 2: Persoonlijke gegevens

Wat is uw geslacht?
- o Man
- o Vrouw

Wat is uw leeftijd?

Wat is de leeftijd van uw kind met diabetes type I?

Hoeveel jaar is het geleden dat bij uw kind diabetes type I werd vastgesteld?

Pagina 3: Uw indruk van robots
Geef uw mening over de volgende stellingen:

Hoe vaak heeft u contact gehad met een robot?
Nog nooit 1 2 3 4 5 *Erg vaak*

Ik vind robots nuttig
Heel erg oneens 1 2 3 4 5 *Heel erg eens*

Ik vind robots sociaal
Heel erg oneens 1 2 3 4 5 *Heel erg eens*

Ik vind robots eng
Heel erg oneens 1 2 3 4 5 *Heel erg eens*

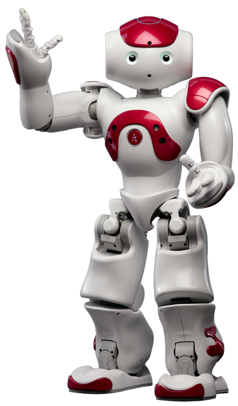
Ik vind dat robots een belangrijke rol in de samenleving hebben
Heel erg oneens 1 2 3 4 5 *Heel erg eens*

Ik vind robots lijken op mensen
Heel erg oneens 1 2 3 4 5 *Heel erg eens*

Ik vind robots intelligent
Heel erg oneens 1 2 3 4 5 *Heel erg eens*

Pagina 4: Factoren van de robot
In verschillende ziekenhuizen in Nederland worden kinderen waarbij diabetes type I vastgesteld is, opgenomen in het ziekenhuis, zoals ook in Ziekenhuis Gelderse Vallei gebeurt. Tijdens de periode van opname krijgen kinderen en ouders uitleg over de theoretische en praktische aspecten van diabetes. Dit onderzoek richt zich op de mogelijkheden van een menselijke robot (zie afbeelding hieronder) die kinderen kan ondersteunen tijdens deze periode. De robot kan bijvoorbeeld de kennis die kinderen hebben opgedaan versterken met een interactieve quiz.
Denkt u bij het beantwoorden van de volgende vragen alstublieft aan dit type robot.

Ziggi robot – ongeveer 60 cm hoog



Ik denk dat de robot emoties kan tonen
Heel erg oneens *1* *2* *3* *4* *5* *Heel erg eens*

Ik denk dat de robot emoties kan ervaren
Heel erg oneens *1* *2* *3* *4* *5* *Heel erg eens*

Ik vind het belangrijk dat de robot emoties toont
Heel erg oneens *1* *2* *3* *4* *5* *Heel erg eens*

Ik denk dat de robot een persoonlijkheid heeft
Heel erg oneens *1* *2* *3* *4* *5* *Heel erg eens*

Ik vind het belangrijk dat de robot een persoonlijkheid heeft
Heel erg oneens *1* *2* *3* *4* *5* *Heel erg eens*

Ik vind het belangrijk dat de robot gebaren gebruikt om zijn spraak te ondersteunen
Heel erg oneens *1* *2* *3* *4* *5* *Heel erg eens*

Ik vind het belangrijk dat de robot niet stil staat, maar beweegt tijdens de interactie met een mens
Heel erg oneens *1* *2* *3* *4* *5* *Heel erg eens*

Ik vind het belangrijk dat de robot oogcontact maakt
Heel erg oneens *1* *2* *3* *4* *5* *Heel erg eens*

Ik denk dat de robot fouten kan maken
Heel erg oneens *1* *2* *3* *4* *5* *Heel erg eens*

Ik denk dat de robot begrijpt wat mijn kind zegt
Heel erg oneens *1* *2* *3* *4* *5* *Heel erg eens*

Ik denk dat de robot nadenkt over zijn gedrag
Heel erg oneens *1* *2* *3* *4* *5* *Heel erg eens*

Ik vind het belangrijk dat de robot details van een interactie met mijn kind onthoudt
Heel erg oneens *1* *2* *3* *4* *5* *Heel erg eens*

Ik vind het eng als de robot details van een interactie met mijn kind onthoudt
Heel erg oneens *1* *2* *3* *4* *5* *Heel erg eens*

Ik vind dat de robot informatie over de interactie met mijn kind mag delen met (meerdere opties mogelijk)

- o Kinderarts
- o Diabetesverpleegkundige
- o Psycholoog
- o Maatschappelijk werker
- o Ouders
- o Niemand
- o Anders, namelijk: …

Ik vind het goed als mijn kind bevriend raakt met de robot
Heel erg oneens *1* *2* *3* *4* *5* *Heel erg eens*

Ik vind het eng als mijn kind bevriend raakt met de robot
Heel erg oneens *1* *2* *3* *4* *5* *Heel erg eens*

Pagina 5: onderzoek
Nadat de resultaten van deze vragenlijst zijn geanalyseerd zal er een onderzoek plaatsvinden waarin kinderen tussen 8 en 12 jaar oud met Diabetes Type 1 een interactie met de robot hebben. De volgende vragen gaan over dit onderzoek.

Ik wil mijn kind mee laten doen met dit onderzoek als (meerdere opties mogelijk):
- o Het leuk is voor mijn kind
- o Het leerzaam is voor mijn kind
- o Het bijdraagt aan nuttig onderzoek
- o Overig, namelijk: …….

Ik wil mijn kind niet mee laten doen aan dit onderzoek als (meerdere opties mogelijk):
- o Het te lang duurt
- o Het te ver rijden is
- o Overig, namelijk: ……

Ik heb interesse om mijn kind mee te laten doen aan dit onderzoek
- o Ja
- o Nee

Als u hier het identificatienummer invult dat in de uitnodigingsmail stond kunnen wij u benaderen met meer informatie over het vervolgonderzoek.
Nummer

Als u de uitkomsten van het onderzoek met de vragenlijst hierboven wilt weten, vult u dan alstublieft hier uw emailadres in:
Emailadres

Pagina 6: Bedankt voor uw deelname
Hartelijk bedankt voor uw deelname aan dit onderzoek. Als u meer informatie wilt kunt u contact opnemen met de onderzoeker Margot Neggers via robotzgv@gmail.com of via 0633677430.

Klik op verzenden om het uw resultaten te verwerken.

Appendix B2 – Online questionnaire children
Leuk dat je meedoet aan dit onderzoek! Lees het volgende eerst even samen met je ouders goed door.

Hartelijk bedankt voor de deelname van uw kind aan dit onderzoek. De volgende pagina geeft u hier informatie over. Voordat uw kind aan de vragenlijst begint is het belangrijk dat u en uw kind kennisnemen van de werkwijze die bij dit onderzoek gevolgd wordt en dat u en uw kind instemmen met vrijwillige deelname. Leest u deze pagina a.u.b. aandachtig door samen met uw kind.

Het doel van dit onderzoek is om informatie te verzamelen voor het verbeteren van een robot die ondersteuning verleent aan kinderen met kortgeleden vastgestelde Diabetes Type 1.
Het onderzoek wordt uitgevoerd door Margot Neggers, student aan de Technische Universiteit Eindhoven onder supervisie van Gert Jan van der Burg, kinderarts van het kinderdiabetesteam van ZGV en van Raymond Cuijpers van de Human-Technology Interaction group.

Deze online vragenlijst vult uw kind in via de webbrowser. Er worden een aantal uitspraken voorgelegd over robots, waarop uw kind zo eerlijk mogelijk antwoord moet geven.

Het onderzoek duurt ongeveer 5 minuten.

Uw kind is geselecteerd omdat hij/zij binnen onze doelgroep valt (8-12 jaar).

Dit onderzoek brengt geen risico's met zich mee, en ook geen nadelige bijwerkingen

De deelname is helemaal vrijwillig. U en uw kind kunnen zonder opgaaf van redenen weigeren om mee te doen aan het onderzoek en de deelname op welk moment dan ook afbreken. Ook kunt u nog achteraf (binnen 24 uur) weigeren dat de gegevens voor het onderzoek mogen worden gebruikt. Wanneer uw kind en u niet mee willen doen, of zich terugtrekken heeft dat geen nadelige gevolgen voor de behandeling of de contacten met het kinderdiabetesteam.

Wij delen geen persoonlijke informatie met mensen of organisaties buiten het onderzoeksteam. De informatie die we met dit onderzoek verzamelen wordt gebruikt voor het schrijven van wetenschappelijke publicaties en wordt alleen op groepsniveau gerapporteerd. Alles gebeurt helemaal anoniem en niets kan naar u of uw kind herleid worden.

Als u nog verdere informatie wilt over dit onderzoek, dan kunt u zich wenden tot Margot Neggers (email: robotzgv@gmail.com, telefoonnummer: 0633677430)

Als u op de startknop druk verklaart u dat u dit document heeft gelezen en begrepen. U stemt ermee in om uw kind vrijwillig deel te laten nemen aan dit onderzoek.

Vanaf de volgende pagina vult uw kind zelf de vragen in. Als uw kind iets niet helemaal begrijpt, of nog moeite heeft met lezen, mag u hierbij helpen.

Toestemming: Ik heb het document gelezen en begrepen. Ik stem ermee in om mijn kind vrijwillig deel te laten nemen aan dit onderzoek en mijn kind stemt hier ook mee in.

Pagina 2: Jouw gegevens
Ben je een jongen of een meisje?
- Jongen
- Meisje

Hoe oud ben je?
Getal

Hoeveel jaar heb je diabetes?
Getal

Pagina 3: Wat vind jij van robots?
De volgende stellingen gaan over robots. Lees eerst de stelling en kies dan hoe goed deze stelling bij jou past.

Ik heb vaker een robot in het echt gezien
- Nog nooit
- Een paar keer
- Heel vaak

Ik vind robots nuttig
- Heel erg
- Best wel
- Neutraal
- Een klein beetje
- Helemaal niet

Ik vind robots aardig
- Heel erg
- Best wel

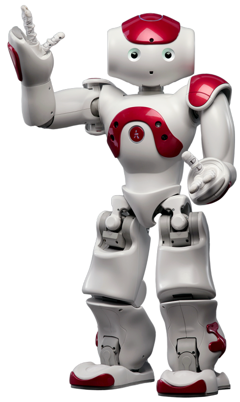
- Neutraal
- Een klein beetje
- Helemaal niet

Ik vind robots eng
- Heel erg
- Best wel
- Neutraal
- Een klein beetje
- Helemaal niet

Ik vind robots lijken op mensen
- Heel erg
- Best wel
- Neutraal
- Een klein beetje
- Helemaal niet

Ik vind robots slim
- Heel erg
- Best wel
- Neutraal
- Een klein beetje
- Helemaal niet

Pagina 4: Robot factoren
Toen de dokter ontdekte dat je diabetes had, moest je misschien een tijdje in het ziekenhuis blijven. Je kreeg toen samen met je ouders les over diabetes.
Wij onderzoeken met deze vragen of een robot kinderen kan helpen tijdens deze periode. Hieronder zie je een foto van onze robot. Denk aan deze robot bij het invullen van de volgende vragen.



Ik denk dat de robot blij kan zijn
- Heel erg
- Best wel
- Neutraal
- Een klein beetje
- Helemaal niet

Ik denk dat de robot verdrietig kan zijn
- Heel erg
- Best wel
- Neutraal
- Een klein beetje
- Helemaal niet

Ik denk dat de robot boos kan zijn
- Heel erg
- Best wel
- Neutraal
- Een klein beetje
- Helemaal niet

Ik denk dat de robot bang kan zijn
- Heel erg
- Best wel
- Neutraal
- Een klein beetje
- Helemaal niet

Ik vind het fijn als de robot zich hetzelfde voelt als ik
- Heel erg
- Best wel
- Neutraal
- Een klein beetje
- Helemaal niet

Ik vind het leuk als de robot beweegt
- Heel erg
- Best wel
- Neutraal
- Een klein beetje
- Helemaal niet

Ik vind het leuk als de robot mij aankijkt
- Heel erg
- Best wel
- Neutraal
- Een klein beetje
- Helemaal niet

Ik denk dat de robot slim is
- Heel erg
- Best wel
- Neutraal
- Een klein beetje
- Helemaal niet

Ik denk dat de robot fouten kan maken
- Heel erg
- Best wel
- Neutraal
- Een klein beetje
- Helemaal niet

Ik denk dat de robot mij snapt
- Heel erg
- Best wel
- Neutraal
- Een klein beetje

- Helemaal niet

Ik vind het leuk als de robot mijn naam onthoudt

- Heel erg
- Best wel
- Neutraal
- Een klein beetje
- Helemaal niet

Ik vind het leuk als de robot mijn hobby's weet

- Heel erg
- Best wel
- Neutraal
- Een klein beetje
- Helemaal niet

Ik wil zelf van de robot weten (klik alles aan wat je van de robot wilt weten):

- De naam van de robot
- De leeftijd van de robot
- De hobby's van de robot
- Het lievelingsdier van de robot
- De lievelingskleur van de robot
- Waar de robot woont
- Nog iets anders, namelijk:

Ik zou vrienden willen zijn met de robot

- Heel erg
- Best wel
- Neutraal
- Een klein beetje
- Helemaal niet

Ik zou het leuk vinden om de robot te ontmoeten

- Heel erg
- Best wel
- Neutraal
- Een klein beetje
- Helemaal niet

Pagina 5: Bedankt
Dankjewel voor het invullen van de vragenlijst! Klik op verzenden om jouw antwoorden op te sturen!

Appendix C – Programming scripts

These are all programming scripts used in the field study to control the robot. There are three Python scripts: one that controlled the robot during the introduction, one that controlled the robot during the game and one that started the server. The HTML-script and the CSS-script are for the tablet interface and the JavaScript-script controls the game on the tablet.

Appendix C1 – Python script introduction

```
import nao_nocv_2_0 as nao
import time

nao.InitProxy("192.168.0.115", [0])
nao.InitSpeech(["Hallo"],"Dutch",wordSpotting=False)

def pause():
    programPause = raw_input("Press the <ENTER> key to continue")

try:
    nao.MoveHead(0,-0.3)   #look at child
    nao.Say("\\rspd=90\\Hallo, ik ben Ziggi! Hoe gaat het met jou?")
    nao.RunMovement("waveGesture.py", post = False)
    choice = raw_input("Goed (g) of Slecht (s):")
    if(choice == "g"):
        nao.MoveHead(0,-0.3)
        nao.Say("Met mij gaat het ook goed!")

    elif(choice == "s"):
        nao.MoveHead(0,-0.3)
        nao.Say("Hopelijk voel je je beter nadat we een spel hebben gespeeld!")

    time.sleep(2)
    nao.MoveHead(0,-0.3)
    nao.Say("Hoe oud ben jij?")
    pause()

    nao.MoveHead(0,-0.3)
    nao.Say("Ik ben pas 2 jaar oud, maar dat merk je niet aan mij.")
    nao.MoveHead(0,-0.3)
    nao.Say("Heb jij broers of zussen?")
    pause()

    nao.MoveHead(0,-0.3)
    nao.Say("Ik heb nog 1 andere robot in mijn familie, die heet Pepper.")
    nao.MoveHead(0,-0.3)
    nao.Say("Wat zijn jouw hobbies?")
    pause()

    nao.MoveHead(0,-0.3)
    nao.Say("Dat vind ik ook heel leuk om te doen!")
    time.sleep(2)
    nao.MoveHead(0,-0.3)
    nao.Say("Wil je weten wat mijn hobbies zijn?")
    choice = raw_input("Ja (j) of Nee (n)")
    if(choice == "j"):
        nao.MoveHead(0,-0.3)
        nao.Say("Ik hou van dansen! Ik kan het heel goed. Kijk maar!")
        time.sleep(3)
        nao.RunMovement("danceGesture.py", post = False)

    elif(choice == "n"):
        nao.Say("Jammer, ik wilde het je graag vertellen.")
        time.sleep(2)
        nao.EyeLED([0,0,255])
        nao.RunMovement("Disappointed.py", post = False)
        nao.EyeLED([255,255,255])

    time.sleep(2)
    nao.MoveHead(0,-0.3)
    nao.Say("Zullen we een spelletje gaan doen?")
    choice = raw_input("Ja (j) of Nee (n)")
    if(choice == "j"):
        nao.MoveHead(0,-0.3)
        nao.Say("Leuk! Ik heb er zin in")
        nao.EyeLED([255,255,0])
        nao.RunMovement("cheerGesture.py", post = False)
        nao.EyeLED([255,255,255])

    elif(choice == "n"):
        nao.MoveHead(0,-0.3)
        nao.Say("Het is een heel leuk spelletje, ik wil het je toch graag laten zien!")
    time.sleep(5)

except Exception as e:
    print "exception ", e

finally:
    nao.Crouch()
```

Appendix C2 – Python script game

```
import server2
import nao_nocv_2_0 as nao
import time
```

```
from random import randint
import sys
import os

nao.InitProxy("192.168.0.115", [0])
nao.InitSpeech(["Hallo"],"Dutch",wordSpotting=False)
nao.InitPose()
nao.Say("\\rspd=95\\ Ik zal het spel uitleggen. We doen een quiz waarbij wij om en om elkaar een vraag stellen. Jij leest een vraag voor mij. Als je klaar bent met lezen druk je op: klaar met voorlezen en dan draai je het scherm om. Dan beantwoord ik de vraag, en lees de volgende vraag voor jou. Als ik het scherm weer heb omgedraaid mag jij deze vraag beantwoorden door het juiste antwoord aan te klikken en ben jij weer aan de beurt om te lezen! Als je het snapt kunnen we beginnen!")

def lookatchild():
	nao.MoveHead(0,-0.3)

def lookattablet():
	nao.MoveHead(-0.4,0.2)

def sad():
	nao.EyeLED([0,0,255])
	nao.RunMovement("Disappointed.py", post = False)
	nao.EyeLED([255,255,255])

def happy():
	nao.EyeLED([255,255,0])
	nao.RunMovement("cheerGesture.py", post = False)
	nao.EyeLED([255,255,255])

def think():
	time.sleep(2)
	lookattablet()
	rnd = randint(1,3)
	if(rnd == 1):
		nao.Say("eum, even denken hoor")
	elif(rnd == 2):
		nao.Say("dit is een moeilijke vraag")
	elif(rnd == 3):
		nao.Say("misschien weet ik het als ik nadenk")
	nao.RunMovement("Thinking.py", post = False)
	lookattablet()

def sendToNao(str):
	if(str == "happy"):
		lookatchild()
		time.sleep(1)
		rnd = randint(1,3)
		if(rnd == 1):
			nao.Say("Wat goed van jou!")
		elif(rnd == 2):
			nao.Say("Wauw, heel erg knap!")
		elif(rnd == 3):
			nao.Say("Wat goed dat je het antwoord wist!")
		happy()

	elif(str == "sad"):
		lookatchild()
		time.sleep(1)
		rnd = randint(1,3)
		if(rnd == 1):
			nao.Say("Jammer, je hebt het geprobeerd")
		elif(rnd == 2):
			nao.Say("Helaas, de volgende keer beter!")
		elif(rnd == 3):
			nao.Say("Jammer, ik vond het ook een lastige vraag")
		sad()

	elif(str == "vraag1"):
		lookatchild()
		think()
		nao.Say("Ik denk dat het goede antwoord, krab, is.")
		time.sleep(4)
		nao.Say("Helaas, het juiste antwoord was slak")
		sad()
		lookatchild()
		nao.Say("De volgende vraag is voor jou! Waar zitten de meeste koolhydraten in?")
		lookattablet()
		time.sleep(3)
		lookattablet()
		nao.Say("Aardappel")
		time.sleep(1)
		lookattablet()
		nao.Say("Appel")
		time.sleep(1)
		lookattablet()
		nao.Say("Vlees")
		time.sleep(2)
		lookattablet()
		nao.Say("Wortel")
		time.sleep(1)
		lookatchild()
		nao.RunMovement("TurnTablet.py", post = False)
		lookatchild()

	elif(str == "vraag3"):
		think()
		nao.Say("Ik denk dat het antwoord insuline, is.")
		time.sleep(4)
		nao.Say("Yes, dat is goed!")
		happy()
		lookatchild()
		nao.Say("Deze vraag is voor jou! Waar bestaat je skelet uit?")
		lookattablet()
		time.sleep(3)
		lookattablet()
		nao.Say("Spieren")
```

```
        time.sleep(1)
        lookattablet()
        nao.Say("Botten")
        time.sleep(1)
        lookattablet()
        nao.Say("Bloedvaten")
        time.sleep(1)
        lookattablet()
        nao.Say("Huid")
        time.sleep(1)
        lookatchild()
        nao.RunMovement("TurnTablet.py", post = False)
        lookatchild()

elif(str == "vraag5"):
        think()
        nao.Say("Volgens mij is het antwoord middelvinger")
        time.sleep(4)
        nao.Say("Ik heb het goed!")
        happy()
        lookatchild()
        nao.Say("Nu ben jij weer! Hoe herken je een hypo?")
        lookattablet()
        time.sleep(3)
        lookattablet()
        nao.Say("Je begint met zweten, beven, je bent moe en je hebt honger, of")
        time.sleep(5)
        lookattablet()
        nao.Say("Je krijgt heel erg jeuk, of")
        time.sleep(2)
        lookattablet()
        nao.Say("Je krijgt heel erg dorst, of")
        time.sleep(2)
        lookattablet()
        nao.Say("Je moet heel veel plassen")
        time.sleep(2)
        lookatchild()
        nao.RunMovement("TurnTablet.py", post = False)
        lookatchild()

elif(str == "vraag7"):
        think()
        nao.Say("Ik denk dat het juiste antwoord is: je bloedsuiker kan stijgen of dalen")
        time.sleep(6)
        nao.Say("Mijn antwoord is goed!")
        happy()
        lookatchild()
        nao.Say("Vraag voor jou! Welk lichaamsdeel lijkt op een computer?")
        lookattablet()
        time.sleep(2)
        lookattablet()
        nao.Say("Vingers")
        time.sleep(2)
        lookattablet()
        nao.Say("Ogen")
        time.sleep(1)
        lookattablet()
        nao.Say("Hersenen")
        time.sleep(2)
        lookattablet()
        nao.Say("Maag")
        time.sleep(2)
        lookatchild()
        nao.RunMovement("TurnTablet.py", post = False)
        lookatchild()

elif(str == "vraag9"):
        think()
        nao.Say("Ik gok tennis")
        time.sleep(4)
        nao.Say("Helaas, ik heb de vraag fout beantwoord. Het was basketbal")
        sad()
        lookatchild()
        nao.Say("Jij mag het weer proberen! Net voor gymles is je bloedsuiker 2.2, wat moet je doen?")
        lookattablet()
        time.sleep(3)
        lookattablet()
        nao.Say("snelwerkende koolhydraten eten")
        time.sleep(4)
        lookattablet()
        nao.Say("Extra snelwerkende koolhydraten eten en je leraar vragen om extra tijd om te herstellen")
        time.sleep(2)
        lookattablet()
        nao.Say("Gewoon gaan gymmen")
        time.sleep(3)
        lookattablet()
        nao.Say("Niet meedoen met gym")
        time.sleep(5)
        lookatchild()
        nao.RunMovement("TurnTablet.py", post = False)
        lookatchild()

elif(str == "vraag11"):
        think()
        nao.Say("Dit weet ik zeker: Ja, je mag alles eten!")
        time.sleep(4)
        nao.Say("Ik had het goed!")
        happy()
        lookatchild()
        nao.Say("Jij bent weer. Welke dieren leggen eieren?")
        lookattablet()
        time.sleep(3)
        lookattablet()
        nao.Say("Kip")
        time.sleep(2)
```

```
                    lookattablet()
                    nao.Say("Koe")
                    time.sleep(1)
                    lookattablet()
                    nao.Say("Hond")
                    time.sleep(2)
                    lookattablet()
                    nao.Say("Hamster")
                    time.sleep(2)
                    lookatchild()
                    nao.RunMovement("TurnTablet.py", post = False)
                    lookatchild()

          elif(str == "end"):
                    lookatchild()
                    nao.Say("Het spel is afgelopen! Ik vond het heel leuk om met jou te spelen, vond jij het ook leuk?")
                    choice = raw_input("Ja (j) of Nee (n)")
                    if(choice == "j"):
                              nao.Say("Fijn!")
                              happy()
                    elif(choice == "n"):
                              nao.Say("Jammer")
                              sad()

          #etc
          print("Javascript zei: "+str)
          return "ok"

server2.startServer(1234, sendToNao)
```

Appendix C3 – Python script server

```
import time
import BaseHTTPServer
import os

HOST_NAME = ''
def listener():
          pass

mime_types = {'.jpg': 'image/jpg',
                '.gif': 'image/gif',
                '.png': 'image/png',
                '.html': 'text/html',
                '.pdf': 'application/pdf',
                '.css': "text/css",
                '.js': "application/javascript"}

def get_file( path):
          f = open(path)
          try:
                    return f.read()
          finally:
                    f.close()

def get_mime(uri):
          return mime_types.get(os.path.splitext(uri)[1], 'text/plain')

def get_content(uri):
          #print("Hallo get "+uri)
          try:
                    if(uri.startswith("/api/")):
                              return api_request(uri[5:])
                    path = './www/' + uri
                    if os.path.isfile(path):
                              return (200, get_mime(uri), get_file(path))
                    if os.path.isdir(path):
                              if(uri.endswith('/')):
                                        path = path + "index.html"
                                        if(os.path.isfile(path)):
                                                  return (200, "text/html", get_file(path))
                                        return (200, 'text/html', "Ja niks")
                              else:
                                        return (301, uri + '/')
                    else:
                              return (404, uri)
          except IOError, e:
                    print("404")
                    return (404, e)

def api_request(uri):
          return (200, 'text/html', listener(uri))

class MyHandler(BaseHTTPServer.BaseHTTPRequestHandler):
          def do_HEAD(s):
                    s.send_response(200)
                    s.send_header("Content-type", "text/html")
                    s.end_headers()

          def do_GET(s):
                    uri = s.path
                    content = get_content(uri)
                    s.send_response(content[0])
                    s.send_header("Content-type", content[1])
                    s.end_headers()
                    s.wfile.write(content[2])

          def log_message(self, format, *args):
                    return

def startServer(port, onApiRequest):
          server_class = BaseHTTPServer.HTTPServer
          global listener
```

```
		listener = onApiRequest
		httpd = server_class((HOST_NAME, port), MyHandler)
		print time.asctime(), "Server Starts - %s:%s" % (HOST_NAME, port)
		try:
				httpd.serve_forever()
		except KeyboardInterrupt:
				pass
				httpd.server_close()
				print time.asctime(),"Server Stops - %s:%s" % (HOST_NAME, port)
```

Appendix C4 – JavaScript scenario trivia game

```
function begin(){
		startProgram();
}

function startProgram(){
		document.getElementById("knopje").style.visibility = 'hidden'
		quiz.showQuestion({
				q: "Luister eerst naar de uitleg van Ziggi. <br> Als je nog vragen hebt kun je die aan de onderzoeker
stellen. <br> Klik hierna op start om de quiz te starten!",
				a:["Start  <br> <br> <br>  <br>  <br>  <br> ",""]
		});
		quiz.onAnswer(question1);
}

function question1(){
		document.getElementById("knopje").style.visibility = 'visible'
		quiz.showQuestion({
				q: "Deze vraag is voor Ziggi: <br> Welk dier heeft vier harten?",
				a:["Tijger", "Slak", "Nijlpaard", "Krab"]
		}, false);
		document.getElementById("knopje").addEventListener('click', fliptablet1)
		//setTimeout(fliptablet1, 15000); //15 seconden wachten voor er een hint wordt gegeven
}

function fliptablet1(){
		document.getElementById("knopje").removeEventListener('click', fliptablet1)
		document.getElementById("knopje").style.visibility = 'hidden'
		quiz.clearWithTitle("Draai de tablet naar Ziggi")
		sendToNao("vraag1")
		setTimeout(question2, 10000) ; // na 5 seconde nieuwe vraag in beeld
}

function question2(){
		quiz.showQuestion({
				q: "Deze vraag is voor jou: <br> Waar zitten de meeste koolhydraten in?",
				a:["Aardappel", "Appel", "Vlees", "Wortel"]
		});
		quiz.onAnswer(answer2Given);
}

function answer2Given(answer){
		if(answer == "Aardappel"){
				sendToNao("happy")
				quiz.clearWithTitle("Dat antwoord is goed!")
		} else {
				sendToNao("sad")
				quiz.clearWithTitle("Helaas, het antwoord is fout. Het goede antwoord was: aardappel")
		}
		setTimeout(question3, 5000)
}

function question3(){
		document.getElementById("knopje").style.visibility = 'visible'
		quiz.showQuestion({
				q: "Deze vraag is voor Ziggi: <br>  Als je hoog zit (hyper), wat heb je dan extra nodig?",
				a:["Water", "Insuline", "Koolhydraten", "Vet"]
		}, false);
		document.getElementById("knopje").addEventListener('click', fliptablet3)
		//setTimeout(fliptablet3, 15000); //
}

function fliptablet3(){
		document.getElementById("knopje").removeEventListener('click', fliptablet3)
		document.getElementById("knopje").style.visibility = 'hidden'
		quiz.clearWithTitle("Draai de tablet naar Ziggi")
		sendToNao("vraag3")
		setTimeout(question4, 10000) ; // na 5 seconde nieuwe vraag in beeld
}

function question4(){
		quiz.showQuestion({
				q: "Deze vraag is voor jou:  <br>  Waar bestaat je skelet uit?",
				a:["Spieren", "Botten", "Bloedvaten", "Huid"]
		});
		quiz.onAnswer(answer4Given);
}

function answer4Given(answer){
		if(answer == "Botten"){
				sendToNao("happy")
				quiz.clearWithTitle("Dat antwoord is goed!")
		} else {
				sendToNao("sad")
				quiz.clearWithTitle("Helaas, het antwoord is fout. Het goede antwoord was: botten")
		}
		setTimeout(question5, 5000)
}

function question5(){
		document.getElementById("knopje").style.visibility = 'visible'
		quiz.showQuestion({
```

```
			q: "Deze vraag is voor Ziggi:  <br>  Welke vingernagel groeit het snelst?",
			a:["Duim", "Ringvinger", "Pink", "Middelvinger"]
		}, false);
		document.getElementById("knopje").addEventListener('click', fliptablet5)
		//setTimeout(fliptablet5, 15000); //
}

function fliptablet5(){
		document.getElementById("knopje").removeEventListener('click', fliptablet5)
		document.getElementById("knopje").style.visibility = 'hidden'
		quiz.clearWithTitle("Draai de tablet naar Ziggi")
		sendToNao("vraag5")
		setTimeout(question6, 10000) ; // na 5 seconde nieuwe vraag in beeld
}

function question6(){
		quiz.showQuestion({
			q: "Deze vraag is voor jou:  <br>  Hoe herken je een hypo?",
			a:["Je begint met zweten, beven, je bent moe en je hebt honger", "Je krijgt heel erg jeuk", "Je krijgt
heel erg dorst", "Je moet heel veel plassen"]
		});
		quiz.onAnswer(answer6Given);
}

function answer6Given(answer){
		if(answer == "Je begint met zweten, beven, je bent moe en je hebt honger"){
			sendToNao("happy")
			quiz.clearWithTitle("Dat antwoord is goed!")
		} else {
			sendToNao("sad")
			quiz.clearWithTitle("Helaas, het antwoord is fout. Het goede antwoord was: Je begint met zweten, beven, je
bent moe en je hebt honger")
		}
		setTimeout(question7, 5000)
}

function question7(){
		document.getElementById("knopje").style.visibility = 'visible'
		quiz.showQuestion({
			q: "Deze vraag is voor Ziggi:  <br>  Wat kan er gebeuren als je buiten gaat spelen?",
			a:["Je bloedsuiker kan dalen", "Je bloedsuiker kan stijgen", "Niks", "Je bloedsuiker kan stijgen en
dalen"]
		}, false);
		document.getElementById("knopje").addEventListener('click', fliptablet7)
		//setTimeout(fliptablet7, 15000); //
}

function fliptablet7(){
		document.getElementById("knopje").removeEventListener('click', fliptablet7)
		document.getElementById("knopje").style.visibility = 'hidden'
		quiz.clearWithTitle("Draai de tablet naar Ziggi")
		sendToNao("vraag7")
		setTimeout(question8, 10000) ; // na 5 seconde nieuwe vraag in beeld
}

function question8(){
		quiz.showQuestion({
			q: "Deze vraag is voor jou:  <br>  Welk lichaamsdeel lijkt op een computer?",
			a:["Vingers", "Ogen", "Hersenen", "Maag"]
		});
		quiz.onAnswer(answer8Given);
}

function answer8Given(answer){
		if(answer == "Hersenen"){
			sendToNao("happy")
			quiz.clearWithTitle("Dat antwoord is goed!")
		} else {
			sendToNao("sad")
			quiz.clearWithTitle("Helaas, het antwoord is fout. Het goede antwoord was: Hersenen")
		}
		setTimeout(question9, 5000)
}

function question9(){
		document.getElementById("knopje").style.visibility = 'visible'
		quiz.showQuestion({
			q: "Deze vraag is voor Ziggi:  <br>  Hoe heet de sport waarbij je een bal door een netje moet gooien?",
			a:["Voetbal", "Hockey", "Tennis", "Basketbal"]
		}, false);
		document.getElementById("knopje").addEventListener('click', fliptablet9)
		//setTimeout(fliptablet9, 15000); //
}

function fliptablet9(){
		document.getElementById("knopje").removeEventListener('click', fliptablet9)
		document.getElementById("knopje").style.visibility = 'hidden'
		quiz.clearWithTitle("Draai de tablet naar Ziggi")
		sendToNao("vraag9")
		setTimeout(question10, 10000) ; // na 5 seconde nieuwe vraag in beeld
}

function question10(){
		quiz.showQuestion({
			q: "Deze vraag is voor jou:  <br> Net voor gymles is je bloedsuiker 2.2, wat moet je doen?",
			a:["Snelwerkende koolhydraten eten", "Extra snelwerkende koolhydraten eten en je leraar vragen om extra
tijd om te herstellen", "Gewoon gaan gymmen", "Niet meedoen met de gym"]
		});
		quiz.onAnswer(answer10Given);
}

function answer10Given(answer){
		if(answer == "Extra snelwerkende koolhydraten eten en je leraar vragen om extra tijd om te herstellen"){
			sendToNao("happy")
			quiz.clearWithTitle("Dat antwoord is goed!")
```

```
        } else {
                sendToNao("sad")
                quiz.clearWithTitle("Helaas, het antwoord is fout. Het goede antwoord was: Extra snelwerkende koolhydraten
eten en je leraar vragen om extra tijd om te herstellen")
        }
        setTimeout(question11, 5000)
}

function question11(){
        document.getElementById("knopje").style.visibility = 'visible'
        quiz.showQuestion({
                q: "Deze vraag is voor Ziggi:  <br>  Kan je alles eten als je diabetes hebt?",
                a:["Nee, je mag geen snoep eten", "Nee, je mag geen koolhydraten eten", "Nee, je mag geen suiker eten",
"Ja, je mag alles eten"]
        }, false);
        document.getElementById("knopje").addEventListener('click', fliptablet11)
        //setTimeout(fliptablet11, 15000); //
}

function fliptablet11(){
        document.getElementById("knopje").removeEventListener('click', fliptablet11)
        document.getElementById("knopje").style.visibility = 'hidden'
        quiz.clearWithTitle("Draai de tablet naar Ziggi")
        sendToNao("vraag11")
        setTimeout(question12, 10000) ; // na 5 seconde nieuwe vraag in beeld
}

function question12(){
        quiz.showQuestion({
                q: "Deze vraag is voor jou:  <br>  Welke dieren leggen eieren?",
                a:["Kip", "Koe", "Hond", "Hamster"]
        });
        quiz.onAnswer(answer12Given);
}

function answer12Given(answer){
        if(answer == "Kip"){
                sendToNao("happy")
                quiz.clearWithTitle("Dat antwoord is goed!")
        } else {
                sendToNao("sad")
                quiz.clearWithTitle("Helaas, het antwoord is fout. Het goede antwoord was: Kip")
        }
        setTimeout(endGame, 5000)
}

function endGame(){
        quiz.clearWithTitle("Dit was het einde van het spel!")
        sendToNao("end")
}
```

Appendix C5 – HTML script interface tablet

```
<!DOCTYPE html>
<html>
        <head>
                <meta charset="utf-8">
                <link rel="stylesheet" href="css/style.css">
                <script type="text/javascript" src="js/ajax.js"></script>
                <script type="text/javascript" src="js/quiz.js"></script>
                <script type="text/javascript" src="js/scenario.js"></script>
                <script type="text/javascript" src="js/main.js"></script>
                <title></title>
        </head>
        <body>
                <div class="container">
                        <div class="header">

                                <div class="content">
                                        <h1 id="question">Quiz!</h1>
                                        <ul id="answers">
                                                <li><a href="javascript:;" class="answer">Start</a></li>
                                        </ul>

                                </div>
                                <div class="knopje">
                                        <button id = "knopje" type="button">Klaar met voorlezen</button>
                                </div>
                        </div>
                </div>
        </body>
</html>
```

Appendix C6 – CSS script interface tablet

```
* {
        margin: 0;
        padding: 0;
        background: #eef;
        color: #20c;
}

div  {
        margin: 0;
        padding: 0;
}

.container {
        position: absolute;
        width: 100%;
        height: 100%;
}
```

```css
.header {
            width: 100%;
            height: 30%;
}

.content {
            float: left;
            width: calc(80% - 50px);
            padding-left: 50px;
}

.logo {
            width: 2%;
            float: left;
            height: 100%;
            text-align: right;
            vertical-align: middle;
}

a {
            text-decoration: none;
}

li::before {
  content: ">    ";
  font-size: 2em;
  color: #11dd00;
}

.logo img{
            position: relative;
            width: 60%;
            height: auto;
            bottom: 0;
            right: 0;
}

button{
            position: fixed;
            right: 50px;
            bottom: 250px;
            font-size: 3em;
            font-family: "Open Sans";
            background-color: #11dd00;
            border: 1px solid #10cc00;
            border-radius: 10px;
}

h1 {
            padding-top: 40px;
            font-size: 3em;
            font-family: "Open Sans";
}

li {
            margin-top: 10px;
            list-style: none;
            font-size: 2.5em;
            font-family: "Open Sans";
}
```

Appendix D – Questions in the trivia game

These are the questions asked in the trivia game, translated from Dutch. The recipient of the question (child or robot) and the context of the question (diabetes or non-diabetes related) is indicated. The right answer to the question is printed in bold.

1. **Robot, non-diabetes**

Which contains the most carbohydrates?
- Tiger
- **Snail**
- Hippopotamus
- Crab

Robot answers: Crab → Incorrect

2. **Child, diabetes**

Which contains the most carbohydrates?
- **Potatoes**
- Apple
- Meat
- Carrot

3. **Robot, diabetes**

When you are high (hyper), what do you need?
- Water
- **Insulin**
- Carbohydrates
- Fat

Robot answers: Insulin → Correct

4. **Child, non-diabetes**

What is your skeleton made from?
- Muscles
- **Bones**
- Blood vessels
- Skin

5. **Robot, non-diabetes**

Which fingernail grows fastest?
- Thumb
- Ring finger
- Little finger
- **Middle finger**

Robot answers: Middle finger → Correct

6. **Child, diabetes**

How do you recognize a hypo?
- **You start with sweating, shaking, you are tired and hungry**
- You get very itchy
- You get very thursty
- You have to pee a lot

7. **Robot, diabetes**

What can happen when you play outside?
- Your blood sugar can fall
- Your blood sugar can rise
- Nothing

- **Your blood sugar can rise or fall**

Robot answers: Your blood sugar can rise or fall → Correct

8. **Child, non-diabetes**

What body part looks like a computer?

- Fingers
- Eyes
- **Brains**
- Stomach

9. **Robot, non-diabetes**

What is the sport called where you throw a ball through a hoop?

- Soccer
- Hockey
- Tennis
- **Basket ball**

Robot answers: Tennis → Incorrect

10. **Child, diabetes**

Right before PE, your blood sugar is 2.2. What do you have to do?

- Eat fast acting carbohydrates
- **Eat extra fast acting carbohydrates and ask your teacher if you can have some extra time to recover**
- Just join PE regularly
- Don't join PE this time

11. **Robot, diabetes**

Can you eat everything if you have diabetes?

- No, you cannot eat candy
- No, you cannot eat carbohydrates
- No, you cannot eat sugar
- **Yes, you can eat everything**

Robot answers: Yes, you can eat everything → correct

12. **Child, non-diabetes**

Which animals lay eggs?

- **Chicken**
- Cow
- Dog
- Hamster

Appendix E – Questionnaire children after interaction

This the questionnaire (in Dutch) filled in by children at the end of the interaction in the field study.

Je hebt net een spel gespeeld met Ziggi de robot. De volgende vragen gaan over de robot. Omcirkel de smiley die het beste past bij jouw gevoel!

Wat vond je ervan om met de robot te spelen?

Wat vond je ervan dat de robot blij was als hij een vraag goed had en verdrietig als hij een vraag fout had?

Wat vond je ervan dat de robot blij of verdrietig kan zijn?

Wat vond je ervan dat de robot zich zo voelt zoals jij?

Wat vond je ervan dat de robot bewoog?

Wat vond je ervan dat de robot jou vragen stelde?

Wat vond je ervan dat jij de robot een vraag mocht stellen?

Wat vond je van de wipwap als manier om een quiz te doen?

Wat vond je ervan dat de robot jou aankeek?

Vond je de robot slim?

Wat vond je ervan dat de robot foute antwoorden gaf?

Denk je dat de robot na moest denken over het antwoord?

Vond je het leuk dat de robot wat over zichzelf vertelde?

Wat zou je nog meer over de robot willen weten?

Zou je het leuk vinden als de robot jou onthoudt?

Zou je vrienden willen zijn met de robot?

Heb je iets geleerd van de robot?

Zo ja, wat dan:

Denk je dat de robot jou nog meer kan leren?

Zo ja, wat dan:

Is er nog iets wat je nog meer wilt vertellen over het ontmoeten van de robot?

Appendix F – Interview questions parents

These are the interview questions (in Dutch) asked to the parents after the interaction in the field study.

Robot factors
U heeft zojuist een interactie gezien tussen de robot en uw kind. De volgende vragen gaan over het gedrag van de robot tijdens deze interactie.

Emotie
Had u het idee dat de robot emoties toonde tijdens de interactie?
Zo ja, hoe heeft u dat gemerkt?

Vindt u het belangrijk dat een robot emoties toont en waarom?

De robot toonde emoties op 2 manieren: door het gebruik van gebaren en door de kleur van de LEDs in de ogen van de robot.

Welke manier is belangrijker en waarom?

Stel de robot zou alleen [minst belangrijke manier] gebruiken, heeft het dan nog steeds hetzelfde effect?

Heeft u gemerkt dat de robot meeleefde?
Zo nee, als uw kind de vraag goed had was de robot blij, als de vraag fout was, was de robot verdrietig.

Vindt u het belangrijk dat de robot de emotie aanpast aan de emotie van uw kind en waarom?

Persoonlijkheid
Vindt u het belangrijk dat de robot een persoonlijkheid heeft? Waarom?

Zag u een persoonlijkheid in de robot?
Zo ja, hoe zou u de persoonlijkheid van de robot beschrijven?

Gesticulatie
De robot maakte tijdens de interactie gebruik van gebaren.

Wat voor gebaren heeft u gezien?

Vindt u het belangrijk voor de interactie dat de robot gebaren toont? Waarom?

Hij maakt twee typen gebaren: betekenisvol (emotie ondersteunen) en niet-betekenisvol (wiebelen op zijn benen en niet stil staan).

Vindt u het belangrijk voor de interactie dat de robot deze beide gebaren maakt? Waarom?

Rol-wisselen
Het kind en de robot stelde elkaar om en om een vraag

Vindt u het belangrijk voor de interactie dat de rol van vraagsteller afwisselt? En waarom?

Had u het idee dat de wipwap tijdens de interactie toegevoegde waarde had? Waarom?

Kijkgedrag
Waar keek de robot voor uw gevoel het meeste naar? Wat vond u daarvan?

Vindt u het belangrijk dat de robot oogcontact met uw kind maakt, en waarom?

Heeft u dat gemerkt?

Hoe natuurlijk vond u het kijkgedrag van de robot?

Vindt u het belangrijk dat de robot natuurlijk kijkgedrag vertoont tijdens de interactie? Waarom?

Intelligentie
Vindt u het belangrijk dat de robot af en toe een vraag fout beantwoordt? Waarom?

Had u het idee dat de robot "nadacht" over zijn vraag?

Wat vindt u ervan dat de robot dit doet?

Voorstellen
In het gesprek vooraf stelde de robot zich voor om het voor uw kind makkelijker te maken om iets over zichzelf te vertellen.

Vindt u het belangrijk dat de robot iets over zichzelf vertelt in de interactie met uw kind? Waarom?

Geheugen
In de situatie waarin de robot gebruikt gaat worden zal het kind in meerdere sessies met de robot interacteren. De robot kan hierbij informatie uit de ene sessie meenemen voor de andere sessie.

Wat vindt u van dit idee? Waarom? Voor- en nadelen?

Vindt u het belangrijk dat de robot details onthoudt van de interactie? En waarom?

Vindt u het eng als de robot details onthoudt van de interactie? En waarom?

Met wie zou de robot de informatie van uw kind mogen delen?

Bonding
Denkt u dat uw kind een vriendschap zou kunnen sluiten met de robot? Waarom wel/niet?

Wat vindt u daarvan? Waarom?

Educatie
Denkt u dat uw kind iets zou kunnen leren van de robot? Waarom wel/niet?

Tenslotte
Wat wilt u verder opmerken over de interactie met de robot?

Hebt u suggesties voor verbetering?