

# Family Brush Story

A voice assistant application that uses interactive storytelling  
to positively influence children's personal oral healthcare

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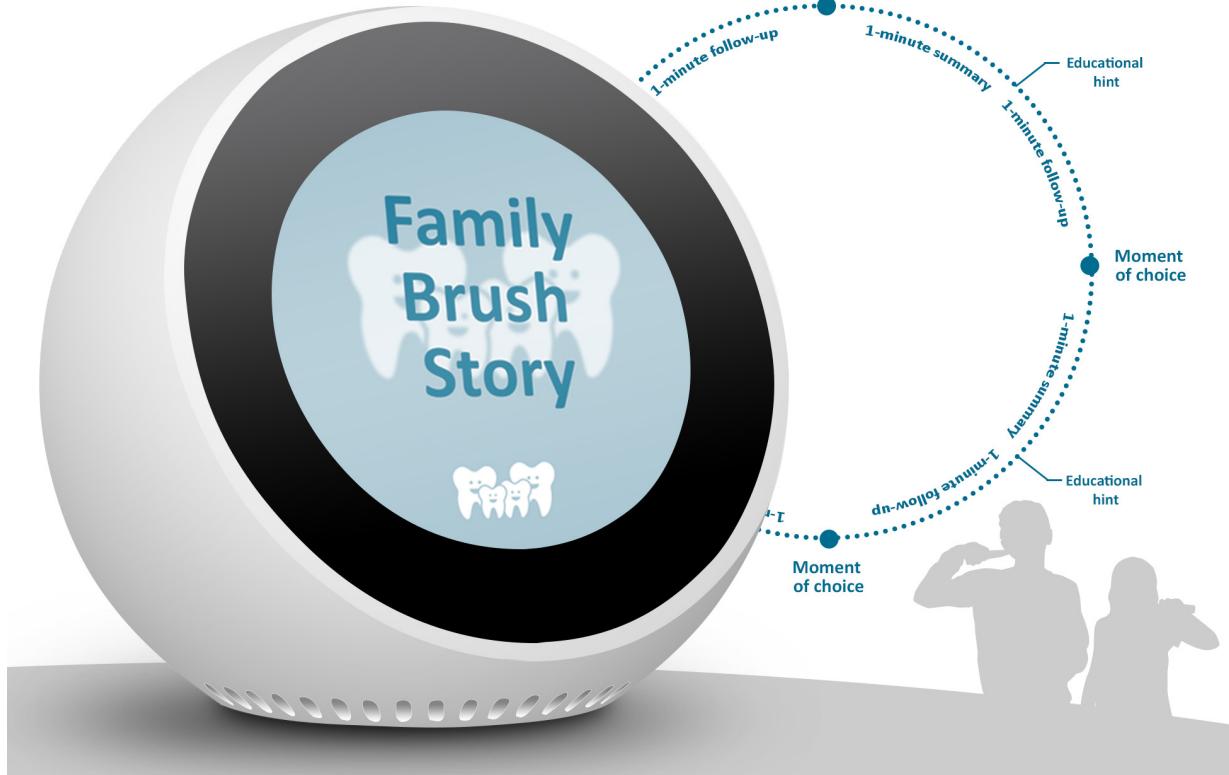
**Project coaches:** Pepijn Verburg

## ABSTRACT

Imagine a world wherein child care is taking over by Voice Assistants. Our challenge has been to design an artefact that improves the personal oral health care routines of children by using voice assistant technology. Research shows that routine and family dynamics influence each other, so we have further researched this finding in our exploratory design research project. With our solution called Family Brush Story, we want to positively influence children's personal oral healthcare, by teaching them correct toothbrushing techniques, by stimulating family dynamics and by helping them to maintain a consistent routine. Due to cliffhangers that act as an incentive, and by helping them to brush properly by giving educational hints that are part of the Family Brush Story Alexa Skill.

## Keywords

oral healthcare; skill; family dynamics; skill flow builder; interactive; voice assistants; consistent routine



**Family Brush Story:** An interactive family story to help improve children's oral health care routines

## INTRODUCTION

Dental caries is the most common chronic childhood disease (Walker, Steinfert, & Keyler, 2014). The prevalence of total dental caries among children is 45.8% in the United States of America (National Center for Health Statistics, 2018). Children who suffer from poor oral health are more likely to experience pain, miss school, perform poorly in school, and exhibit poorer growth, body weight, quality of life, and cognitive development (Walker et al., 2014, p. 918). Another aspect of the problem is that children from low income families are often not guaranteed to have dental insurance in the US (National Center for Health Statistics, 2018).

The good news is that caries is preventable. Caries is due to an inconsistent routine and bad quality of brushing. For instance: brushing with the wrong pressure and brushing less than 2 minutes (Gill, Stewart, Chetcuti, & Chestnutt, 2011) (data analysis). Brushing properly and consistently are the most important interventions to prevent caries (Walker et al., 2014).

The challenge is to design an artefact that improves the personal oral health care routines of children by using the voice assistance technology. The target group of this project are children between eight and twelve years old, that live in the United States, have poor oral hygiene routines and are equipped with an electric toothbrush and an Amazon Alexa Echo Spot. Voice assistant technology is part of this challenge because this technology is growing in popularity. Voice assistants, such as the Amazon Alexa and the Google Home, are more and more integrated into family's homes. In the United States of America more than 75 million smart speakers with voice assistance are installed. A smart speaker with voice assistance provides new ways of interaction compared to a smartphone. People often don't carry their phones in the bathroom thus a voice assistant can contribute to positive behaviour towards oral health care routines.

The data analysis from our client has shown that routine and family dynamics influence each other. A consistent routine is due to good family dynamics and/or good family dynamics are a result of a consistent routine. Furthermore, children brush their teeth because they are told to by their parents and because

it is part of their routine (Gill et al., 2011). Other research has shown that a voice assistant contributes to family bonding and building social and emotional connections (Beirl, Rogers, & Yuill, 2019). Families develop new rituals and encourage each other to take part in games with Alexa (Beirl et al., 2019). These interactions are contributing to social and emotional bonding, leading to further family cohesion (Beirl et al., 2019). However, interactions that occur are not always harmonious and sometimes lead to family disputes (Beirl et al., 2019). Our hypothesis is that interactions that provide collaboration between family members improves the family dynamics. The solution is to influence the family dynamics with a collaborative Alexa skill to regulate the routine and to create a higher quality of brushing.

This will cause children to have better personal oral healthcare, thus prevention of caries. Not only children benefit from this solution. Parents or caregivers will also benefit because children are more likely to brush correctly and consistently which will result in lower healthcare costs due to the prevention of caries.

## RELATED WORK AND BENCHMARK

### The target group

In general, children between eight and ten years old like to be seen as the authorities on their favorite topic. Children in this age group prefer more complicated, challenging interfaces but they don't read instructions, which is why using confirmation and error messages to provide incremental instruction is very powerful. Because they are starting to realize that adults do not have all the answers, children in this age group feel more empowered to push back on rules, ideas and directions. Activities that require dexterity, skill, accomplishment, and the ability to improve over time fit this age group, because they like things that provide more of a complex 'journey' in which they can learn, grow and discover over time. Girls tend to prefer games requiring exploration, discovery, and collaboration while boys prefer competition, action and advancement (Gelman, 2014).

According to Gelman (2014), ten to twelve year old's do not want to be treated as little kids anymore. They are able to interpret complex scenarios and imagine all the possible outcomes of their actions and decisions. This is why games based on pure exploration can be intimidating for them. They reflect on every decision point, and it can paralyze them.

*"If your design focuses on the story, you will make ten to twelve year old's very happy. In addition to the ability to imagine different outcomes associated with their actions, they can also think creatively."*

While younger users are primarily interested in the journey, the ten to twelve year old's are starting to become focused on the outcome and the destination.

It is important to allow kids to create their own personal narratives within digital environments, while steering away from 'right and wrong' or 'black and white' and instead, focus on the grey areas in between. The need to celebrate individuality is important to consider when designing for this age group.

### Children's motivators to brush

Children brush their teeth because they are told to by their caretakers, because they want to clean or refresh their mouth, because it is routine and because of health reasons, as children tend to be afraid that their teeth will fall out (Gill, Stewart, Chetcuti, & Chestnutt, 2011) (Stokes, Ashcroft, & Platt, 2006).

Study results clearly indicate that children's strongest motivation for brushing is to have pretty, white teeth, which is mainly due to viewed media pictures of "perfect" teeth. Social media plays a key role in some children's understanding of the negative health consequences of poor oral health. This understanding motivates children to brush their teeth better which means that home computers can be used as an external motivator to deliver tailored messages to encourage better brushing (Walker, Steinfort, & Keyler, 2014). The primary content and framing of messages, therefore, should focus on the gain frame of the aesthetic benefits received from brushing. The finding that teeth are considered most important due to their contribution to appearance has also been found in studies with adolescents of slightly older ages (Stokes, Ashcroft, & Platt, 2006). Some children also relayed experiences hearing the media, family, and dentists say that brushing is required. It is the "right thing" to do. The majority of children in this study seemed to be motivated to brush on their own in order to please others; a few had the desire to do so to avoid the consequences received from parents (Hepach, Vaish, & Tomasello, 2012).

## Voice assistants

A voice assistant is a smart personal helper with a Voice User Interface (or VUI). A VUI is an interaction model where a human interacts with a machine and performs a set of tasks at least in part by using voice (Dasgupta, 2018).

Interacting with a voice assistant feels intuitive, interactions are hands free and quick, and the user creates an emotional bond with the voice assistant (Dasgupta, 2018). A study shows that most users describe interacting with a voice assistant for entertainment purposes or for its assistant functions (Purington, Taft, Sannon, Bazarova, & Taylor, 2017).

Nevertheless, there are some disadvantages to take into account as well. The context of the user can't be understood by the voice assistant. The same words can have a different meaning in different contexts. Also, the context of the user can switch during the interaction. The voice assistant does not understand when the user is switching to having a conversation with other people. Furthermore, complex questions of users are considered not to be understood by the voice assistant.

When designing for a VUI there are some requirements to take into account. The interaction with a VUI should be short, with minimum back and forth interactions. A VUI should not provide more than three to four options to the user at once. After providing the options, the user can ask for more if they want.

Voice assistants are widely integrated in smart speakers. The market leaders are Google Home and Alexa (Dale, 2019). In this project the voice assistant of the Alexa Echo Spot, will be used. The applications used by Alexa are called Alexa Skills. Currently, there are several Alexa toothbrush skills for children available ("Alexa Skills | Amazon.com", z.d.). Bathroom Buddy is a skill that teaches children to brush their teeth and wash their hands properly. You can set a timer for brushing teeth, ask to be sung to while you wash your hands, and get info on brushing, flossing, washing. Toothbrush Time helps children to enjoy brushing their teeth while listening to a fun toothbrush song. It helps prevent stressful battles between children and parents about toothbrushing. Chompers is a skill that makes tooth brushing fun with a morning and night teeth brushing show for kids from 3 to 7 year old. The show consists of jokes, stories, fun facts and songs that will motivate children to brush for two minutes. Toothbrush Timer is a simple skill that helps children brush for the recommended 2 full minutes. It provides hints and encouragement along the way. Choose Your Own Adventure is not related to toothbrushing, but provides children an interactive story. Children make decisions on what happens next in a story.

## Family dynamics

Playing games and music together can contribute to family bonding and building social and emotional connections (Boer et al., 2014). Beirl et al. (2019) researched the usage of voice assistant skills in family life. They observed many forms of family cohesion across all families. These were classified in terms of shared laughter, teasing, exchanging gestures and facial expressions and family rivalry. The findings demonstrated that family members developed new family rituals and encouraged each other to talk to and take part in games with Alexa. Many of these interactions, like playing games and music together could be seen as contributing to social and emotional bonding, leading to positive family dynamics. Alexa was also found to encourage families to jointly act out together, namely singing and dancing. Having an external participant made this appear like a performance, as evidenced by parents sometimes referring to Alexa as a potential audience.

However, the interactions that occurred were not always harmonious and sometimes led to family disputes. This reflects the richness of family life, where children learn to compete with their siblings but also learn to empathize with them (Beirl et al., 2019).



Figure 1: Competing Alexa skills

## FAMILY BRUSH STORY

### Family Brush Story, the concept

Family Brush Story is a voice assistant application that uses interactive storytelling for the whole family to positively influence children's personal oral healthcare. Dental caries is the most common chronic childhood disease and is due to an inconsistent routine and bad quality of brushing. Family Brush Story helps to prevent dental caries through teaching children correct tooth brushing techniques by providing educational hints and through helping them to maintain a consistent routine by using cliffhangers as an incentive. The story is influenced by choices given at the end of each toothbrushing session. Because all participating family members are making choices that influence the course of the story, they are collaborating and directing the story together. While research shows that routine and family dynamics influence each other, Family Brush Story stimulates these family dynamics as well. It makes toothbrushing a shared activity, gives parents insights in the preferences of their children about actual subjects, and causes family talks.

During brushing, the user listens to a two minute story about an actual subject, such as liberation day or christmas. The story consists of a summary of the story that was created since the last toothbrushing session of that particular user, and a new part of the story that flows into a question. After these two minutes, the user has brushed long enough and can answer the question that influences the upcoming part of the story.

### Technology and Realization

The demonstrator of Family Brush Story is built by writing syntax using Skill Flow Builder, an Amazon Alexa tool. The concept consists of a main storyline structure with corresponding variables and interaction modules. The main storyline is affected by each family member, which means family members are collaborating and influencing each other's stories. During brushing a family member listens to a one-minute story/summary that is influenced by choices of other family members since the last toothbrushing session. Halfway the story, an educational hint about toothbrushing is implemented. Then, an one-minute story follows that flows into a question. After two



**Figure 2:** Educational hint, concept visualisation

minutes of brushing the family member stops brushing and answers a question of the Alexa that is related to the story. The answer is presented on the screen of the Alexa since it helps users to keep track of what is happening or expected from them. The answer given by the user is translated into a variable and will influence the story for the next family members. The navigation actions to interact with the story consist of the commands: pause, resume, stop, go back, help and repeat the question. These interactions are essential because they help users to control the skill.

### Underlying Design Principles

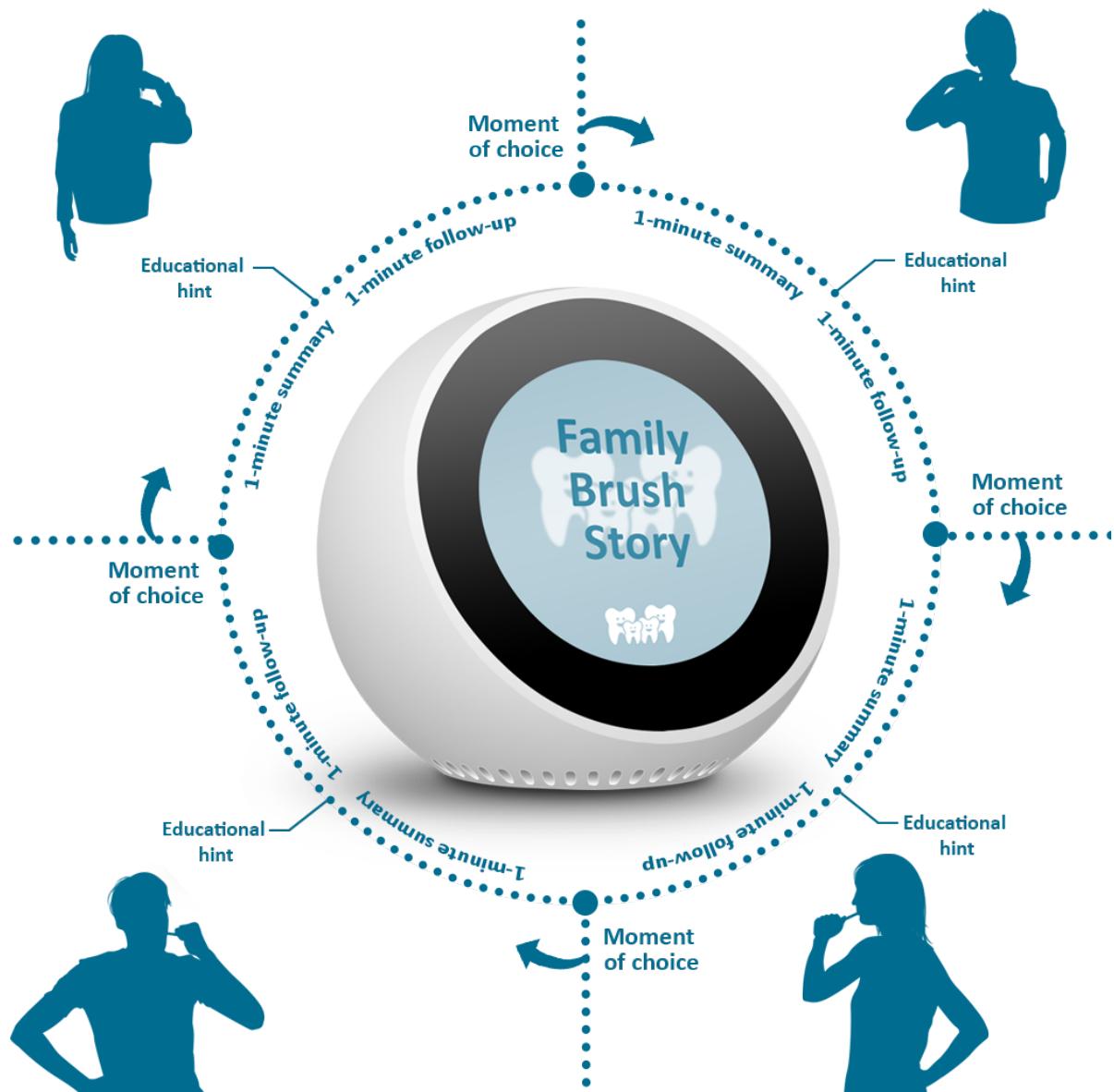
The concept focuses on two points, namely routine and family dynamics. The cliffhangers in the story that act as an incentive help children to maintain a consistent routine. The positive influence of the concept on the

routine is momentary. Because users don't immediately hear the next part of the story and therefore the effect of their choice, they are triggered to come back and brush their teeth again. Furthermore, a consistent routine is positively influenced by family dynamics. The concept stimulates the family dynamics by making toothbrushing a shared activity, by giving parents insights in the preferences of their children about actual subjects, and by causing family talks. Family members will engage and talk about the story. They can discuss how the story goes during daily activities such as having dinner or driving in the car. The concept is surprising due to the ability to make choices that influence the course of the story and due to the fact that a user does not create the story on its own.

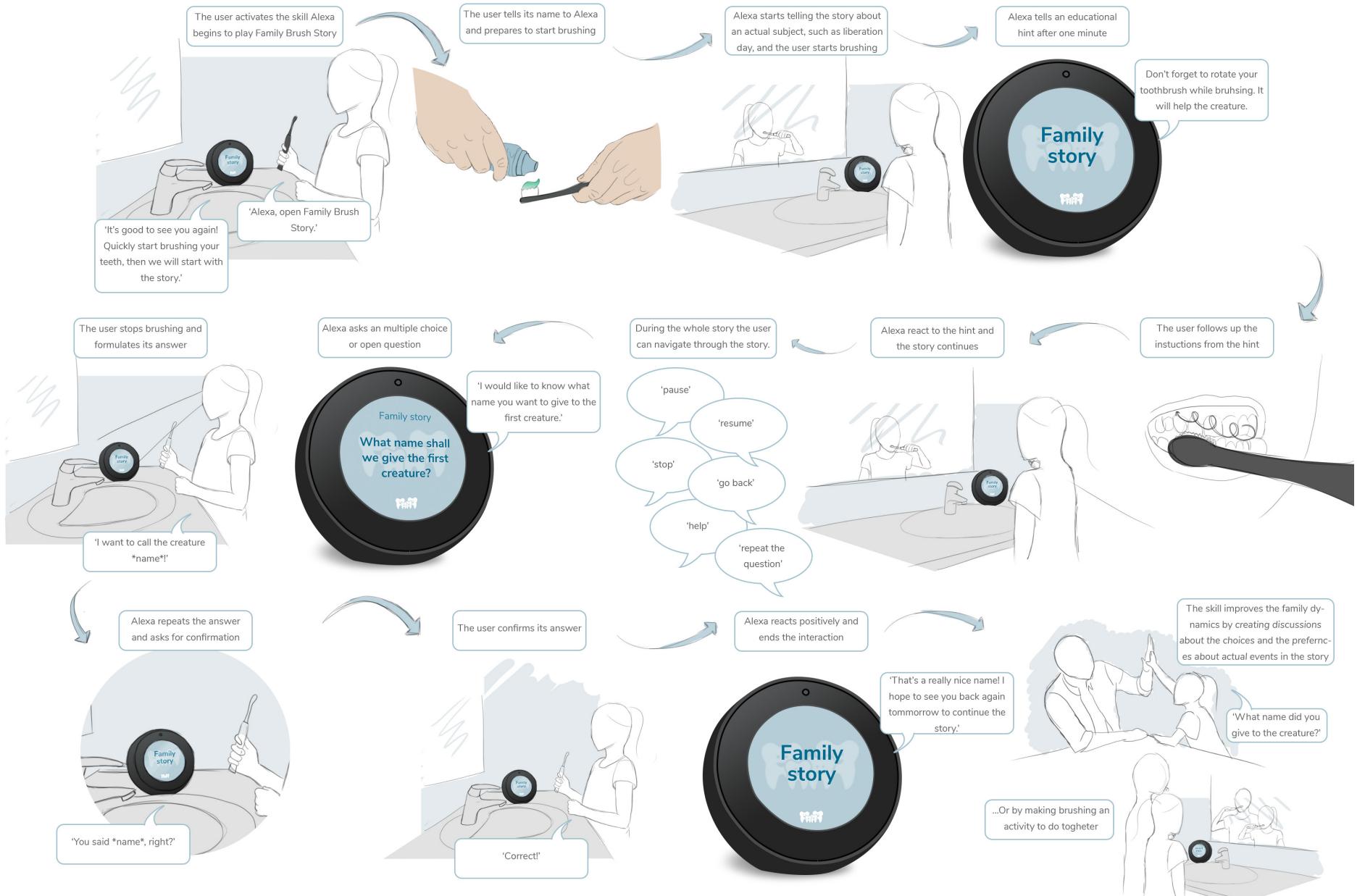
The target group of the concept, children of the age group 8 - 12 years, is curious and wants to explore

options. The concept is explorative due to the fact that the upcoming part of the story is unknown. The story is influenced by the family, creating a constant factor of surprise. It might even be good to add an option to go back to a specific moment in the story where a choice was made. This way, the effects of making other choices than the ones previously made can be explored.

The structure of the two-minute story and the hints make the concept educative. For example, Alexa provides a hint after one minute to apply less pressure with the brush. The summary of the story created by yourself and others will be one minute long. After this minute, a new part of the story will begin. This part of the story is linked to the question that will be asked at the end of the toothbrushing session. Because the story is split in half, this is a good moment to switch from brushing the bottom teeth to the upper teeth. This division of the story therefore acts like a timer that people can use as a guide to brush the teeth properly.



**Figure 3:** Family Brush Story timeline



**Figure 4:** Family Brush Story scenario

## FUTURE OF FAMILY BRUSH STORY

While voice assistants are integrated more and more in people's life and AI is rapidly growing, we created a possible future wherein Family Brush Story is implemented. This analysis consists of a future 'what-if scenarios' based on a 'future vision' that is based on literature research and speculations. The analysis also contains a possible 'future world'; a method to explore new technologies and products. The aim of this analysis is to inspire and to help make decisions for the further development of Family Brush Story.

### Future vision concerning VUI's and oral health care

We created a future vision by speculating based on related work and a benchmark on two specific subjects: voice assistants and oral health care products. We address four different points of our future vision concerning these subjects.

First of all, natural language interfaces, such as voice user interfaces (VUI), have moved out of the industry research labs and into the life of the general public (Moore, Szymanski, Arar, & Ren, 2018). The VUI is finding its way in smart homes (Ikea's smart blinds, Orient's smart ceiling, or Instant Brand's smart pressure cooker) and smart vehicles (Drivetime, Apple CarPlay, Android Auto). Furthermore, VUI is finding its way in other sectors as well. Voice assistants are even being implemented in the medical sector (Damacharla et al., 2018, p. 134) or scientific sector (Austerjost et al., 2018, p. 480). Based on this information, we think the next generations of voice assistants will take over more and more tasks from people. VUI's will be able to understand and react to the behaviour and routines of people. Due to the voice assistant taking over tasks from people, we think that voice assistants will develop a higher sense of responsibility.

Another point we want to address here is that natural language processing is becoming more advanced (Moore et al., 2018). An upcoming trend in the hype cycle of emerging technologies (Gartner, Inc., 2019) is the rise of 'emotion AI'. However, the current VUI's can't measure emotions of the user. Due to the basic human expectations a user has about a conversation, the interaction with a VUI needs to be human-like (Moore et al., 2018), thus involve emotions. We think that voice assistants of the future are able to

measure, understand, and react to the emotions in the tone of the voice of its users. This will create a more human-like interaction and create a more realistic user experience.

Another important point to address is that the VUI on itself could be seen as a limited interface. An insight from our first user test is that remembering verbal options to give a considered answer is experienced as difficult for a user. However, the issue of the user having a limited memory can be solved by utilizing multimodality between other interfaces and a voice user interface (Larson, 2019). We think that VUI's in the future will be able to connect to other devices with supporting interfaces, or functions.

According to Phillips, connected technology and smart sensors are the future for oral healthcare (Philips, 2017). New toothbrushes such as the Philips Sonicare FlexCare and DiamondClean, Oral-B Genius X, and Colgate Smart Manual Toothbrush, use real-time data to provide advice and guidance. This will lead to better oral health care habits. Often, these toothbrushes are connected with a mobile phone application. For children there are toothbrushes available with interactive games that are often connected to an app. The aim of these apps is to entertain or to teach good oral health care habits. We think that oral health care products in the future will focus on the experience. The experience of brushing will become more effective by collecting data. The collected data is used to improve the oral health care habits of the user. There will be a growing demand for toothbrushes that collect data to provide real-time interaction and personalized feedback. Furthermore the experience of brushing is becoming enjoyable. Real-time interaction and personalized feedback, is provided in an interesting and fun way to motivate children.

### Future world

To create a future world, we analysed 'future signals', new technologies and new products in three different domains. Then we defined their 'unusual qualities', qualities that make something different from the mainstream, and searched for common unusual qualities between the new technologies and new products (Appendix II: the three domains and their unusual qualities).

The first domain we analysed is voice assistants. Common unusual qualities of products and technologies in this domain are flexibility and human-likeness. The second domain we analysed is oral health care. The common unusual qualities we found here are connectedness, implementation of artificial intelligence, and real-time feedback. The third domain we analysed is oral health care for children. Common unusual qualities we found in products and technologies in this domain are multi-experience and monitoring.

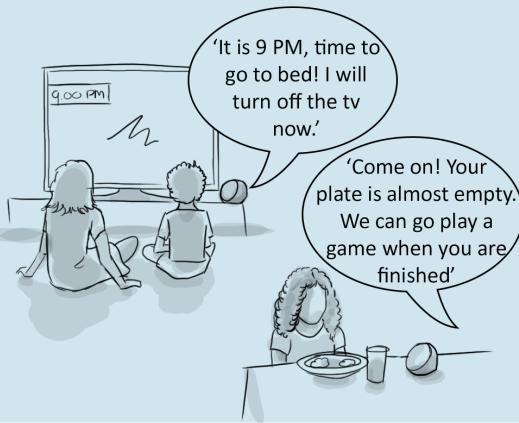
Thereafter, we compared the unusual qualities of all domains and searched for patterns in the common usual qualities. We used these insights to create a 'future world' (Figure 5). The future world we created values flexibility and connectedness. In this world people are constantly connected with devices and devices are constantly connected with other devices. Flexibility is of utmost importance while people are expected to be accessible everywhere. Also, all systems fit all devices, and vice versa. The (multi-) experience with products or systems is getting more important. The interactions that support these experiences are becoming more human-like. Products collect data to monitor and give real-time feedback to improve the experience and skills of people.

## 'The future world of Family Brush Story'

This world values flexibility and connectedness. People are constantly connected with devices and devices are constantly connected with other devices. Flexibility is of utmost importance while people are expected to be accessible everywhere. Also, all systems fit all devices, and vice versa. The (multi-)experiences with products or systems is important. The interactions that support these experiences are human-like. Products collect data to monitor and give real-time feedback to improve the experience and skills of people.



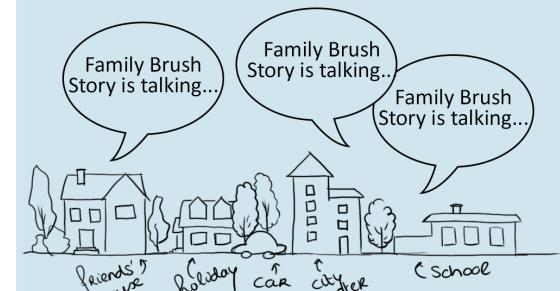
What if a voice assistant takes over the complete child care by understanding and reacting to the behaviour and routines of the user, and by developing a feeling of responsibility?



What if interacting with a voice assistant will be the same as interacting with a real human, in a way it will have a character, understands and reacts to the emotions of the user?



What if the same voice assistant has the flexibility to connect to all devices at all places in the life of people?



**Figure 5:** Future world and 'What If' visualisation

## VALUE PROPOSITION

Our Alexa skill Family Brush Time, helps families that want to improve their children's oral health care. The skill does this by creating a more consistent routine and by positively influencing the family dynamics which is unlike other toothbrush applications and skills, that focus on routine and entertainment only.

### Customers, consumers, and client

There are three main stakeholders in the business case of Family Brush story. The customers of Family Brush Story are parents of children aged 8 - 12 years old. They are the people that will buy or get Family Brush Story for their children, as they want their children to have good oral healthcare, prevent extra dental costs, and avoid family disputes. Family Brush Story positively influences the family dynamics, thus helps to avoid family disputes and causes a consistent routine within the family. A consistent routine with good toothbrushing techniques causes a good oral healthcare and prevents extra dental costs.

The consumers of Family Brush Story are the users of the skill, thus families that consist of parents and children. Family Brush Story supports the oral health care routines of families by pushing them to collaborate. Providing a variety of fun stories with exciting cliffhangers and interesting questions. Furthermore, Family Brush Story influences the family dynamics by creating extra moments between family members after and before brushing (I), creating moments of choice that influence the story for other family members (II), giving parents indirect insights on the preferences of their children on actual subjects (III), and providing a platform to buy stories (IV).

The last stakeholder of this project would be the client, which will exploit the insights of our research and concept Family Brush Story. The skill is built to be an addition to their current product range and will add value for both the customers and the consumers. The client's product range is shifting towards health products. While this client values personal health care more, Family Brush Story is an innovative addition to their current product range in personal oral healthcare. Children will find toothbrushing more fun and do it properly, resulting in less pressure on the parents to educate or push their kids to brush their teeth correctly. This means that Family Brush Story can be marketed towards both, creating a higher chance of success when utilizing the opportunities as presented.

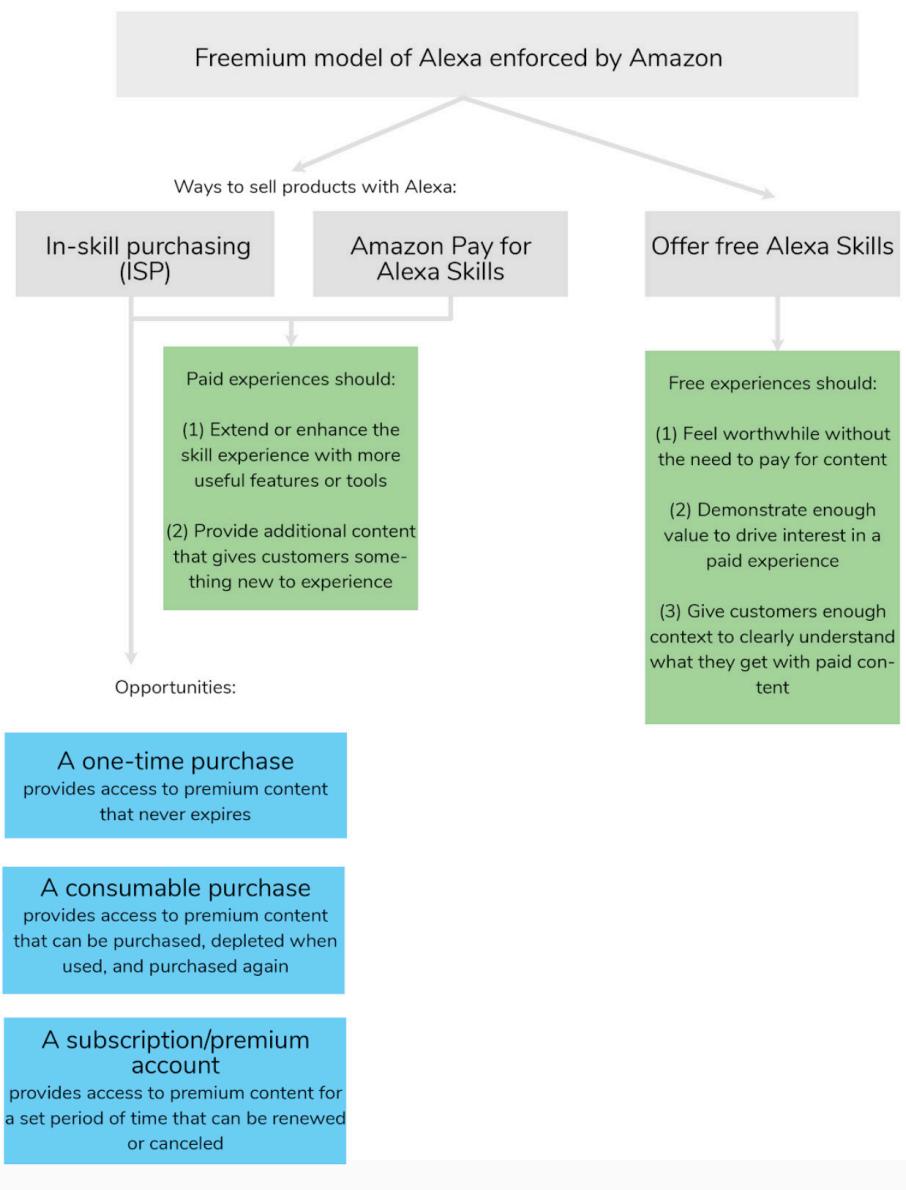


Figure 6: Business environment of Alexa Skills (Alexa Skills Kit Official Site: Build Skills for Voice", 2020)

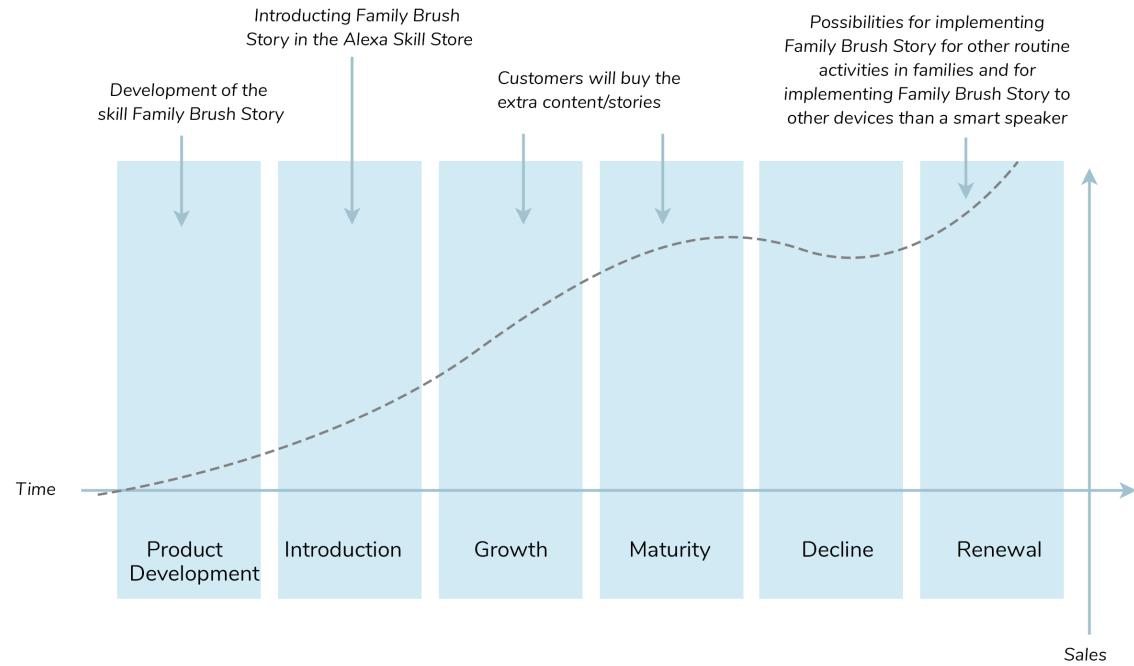
## (Future) business model

Alexa works with a freemium business model that is enforced by Amazon (Figure 6). This model provides skills for free. Extra content to extend the experience can be purchased.

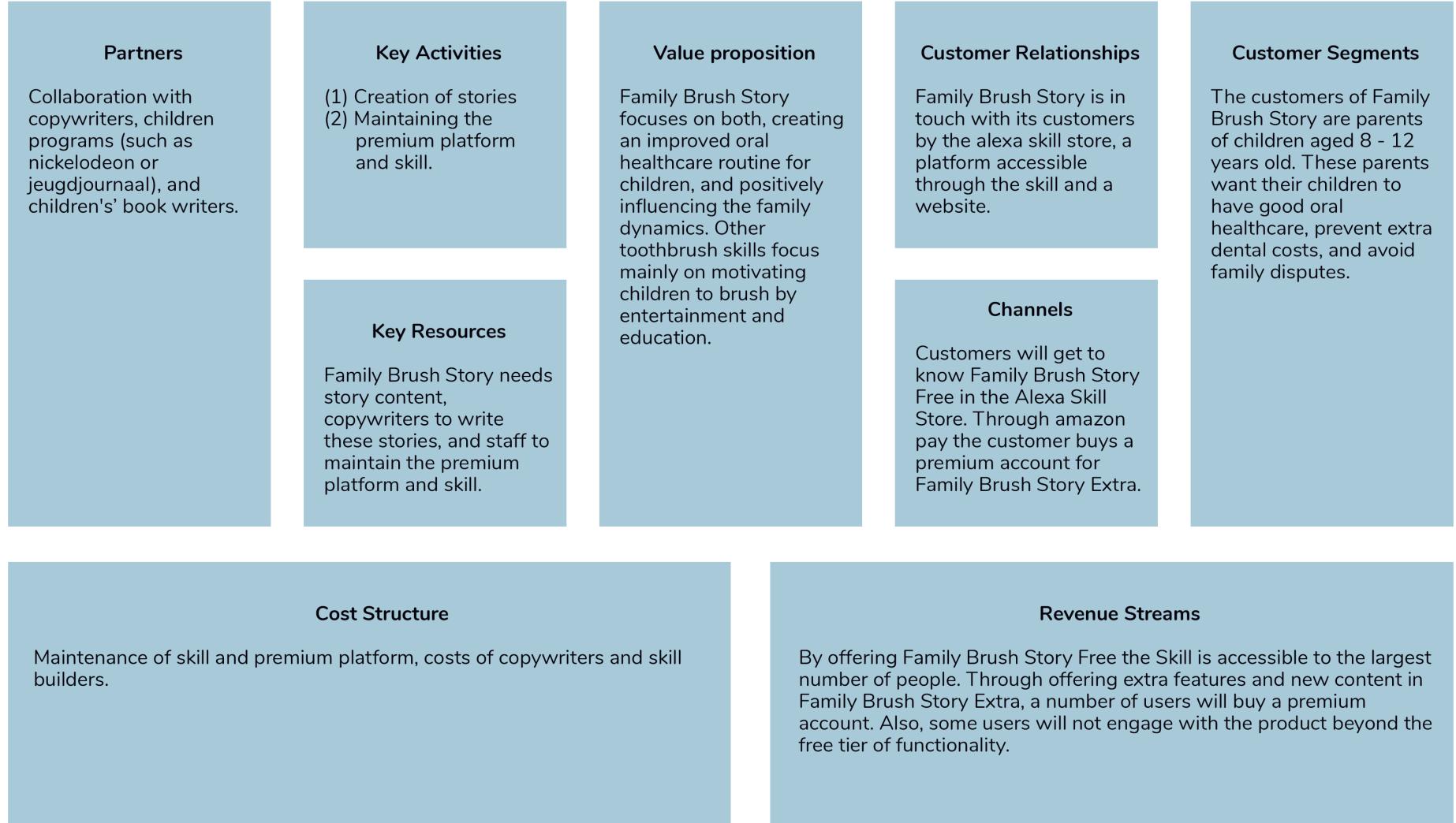
We created a business model that is divided into two parts. We have got a part for the current situation and an option for the near future.

In the current situation, Family Brush Story will be provided to the customer for free via 'Alexa Skill Store'. The free skill provides a worthwhile experience by providing basic stories about actual events. The experience of Family Brush Story can be extended by purchasing new stories through Amazon Pay via a one time purchase. This could also be done on a package deal, or license base. The stories within the skill can be written in collaboration with copywriters, children book writers, and children's programs such as Nickelodeon or Disney which creates the opportunity to use their expertise and publicity in the benefit of the skill.

As mentioned in the future scenarios and review analysis, there are possibilities that the next generations of voice assistants will take over more and more tasks from people by understanding and reacting to the behaviour and routines. The business model of Family Brush Story for the near future is built upon this view. Besides the skill Family Brush Story, there will potentially also be skills for other family routines, such as preparing to go to school ('Family Morning Routine Story'), or finishing your plate ('Family Dinner Story'). These skills will be part of a complete system, called Family Routine Skills, that could be offered to the customer via a license. The next generations of Family Routine Skills can create growth in the renewal stage by expanding and focussing on more routines, as shown in figure 7.



**Figure 7:** Product life cycle of Family Brush Story



**Figure 8:** Business Model Canvas for Family Brush Story

## ETHICAL CONSIDERATIONS

### Designer's intention

The intention of us as designers is to prevent the most common chronic childhood disease, namely dental caries. Family Brush Story prevents caries by creating a consistent brushing routine, positively influencing dynamics, and creating a positive brushing experience. Positive consequences are that children brush more regularly and that the family dynamics will be enhanced. This will improve children's oral health care.

During the design process, it was important for us as designers to keep in mind we were designing for children. We researched how to design for this target group, as it has consequences for both the design itself, as the user tests that will take place during the design process. For these user tests, we learned that we should use an adult consent form and a child consent form. The adult consent form for the parent should clearly state everything that will happen and what is or can be expected from all parties. This consent form is detailed and elaborate, whereas the children's consent form is relatively short, simple and basic.

In this case, the interviews were conducted with the parent and the child together. We dived into interview techniques suitable for children and used our findings to set up an appropriate user test. Involving both children and their parents during the design process helped us to gather insights from both angles.

### Potential unethical situations

First of all, we designed for children living in the USA. We are designers from the Netherlands and conducted user tests with Dutch children. Thus there was a culture difference to take into account during the design process. Culture sensitivity might play a role due to this difference. We tried to take this into account as much as possible. For example, we looked into the difference between health insurance in the USA and the Netherlands.

Second, the skill needs to be suitable for children and should not expose children to hazards. In the future vision is mentioned that there is a chance that voice assistants take over child care. The combination of childcare and technology can be seen as sensitive, as these tasks require a high level of responsibility. Technology should not have the complete responsibility in childcare tasks. The first requirements to take into account is that only parents should be able to purchase the skill and children need permission from their parents to use the skill for the first time. Also, the skill should not harm children's feelings, should live up to their expectations and addiction to the skill needs to be prevented.

And lastly, while a voice assistant is continuing listening it is important the data is not collected or shared with other parties. This may violate the privacy of the users. Future developers should be aware of this issue.

## DESIGN PROCESS

The iterative design process of this project is comparable to the double diamond model, thus including two stages that contain the subjects:

discover, define, develop, and deliver. We explain the methods we used and the major decisions we made during each iteration.

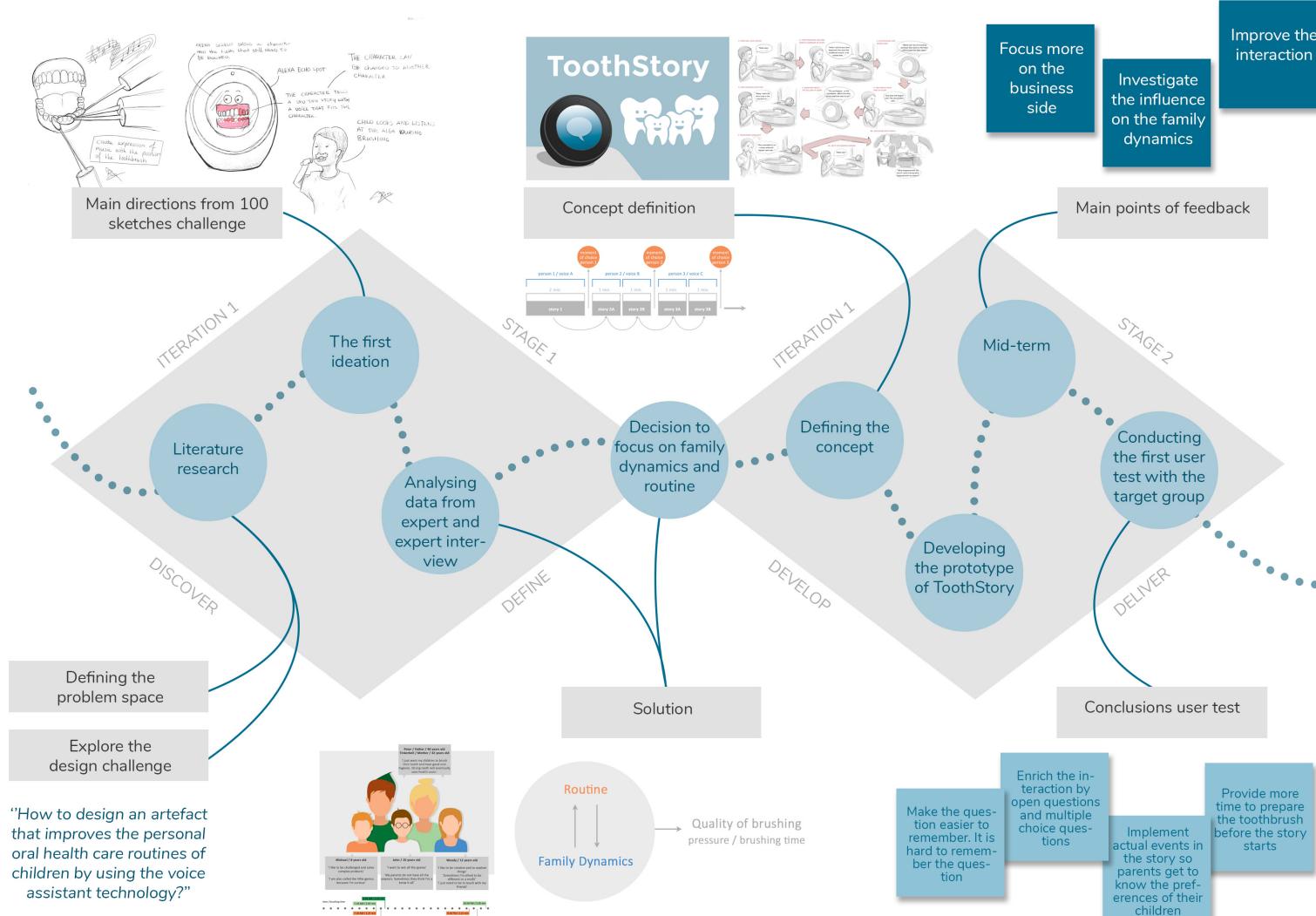


Figure 9: Design process iteration one

## Iteration one

### The problem space, first ideation and main direction

During the first stage of iteration one, we discovered and defined the problem space. This started with literature research, which consisted of reading related work and doing a benchmark on the topic. At the same time, we made 100 sketches to generate ideas, define interesting topics and find directions in which the project could go. Based on these sketches, we identified six directions: (I) personification, (II) learn through (playful) experience, (III) use of a physical product and/or physical feedback, (IV) creating a routine, (V) rewarding the user, (VI) and collaboration & co-responsibility.

To explore the problem further, we conducted a data analysis on previous research done by experts that were available through collaboration with the University. We also interviewed the experts that conducted this research, to gain insights on their process. Based on this research we chose a main direction out of the list of topics as mentioned before. We decided to focus on the family dynamics and routine due to the fact that these two parameters seem to be influencing each other. A consistent routine is due to good family dynamics and/or good family dynamics are a result of a consistent routine. Our hypothesis is therefore that positively influencing the family dynamics, will regulate the routine and create a higher quality of brushing or vice versa.

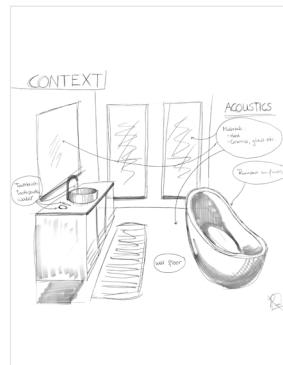


Figure 10: Sketch 18



Figure 11: Sketch 58

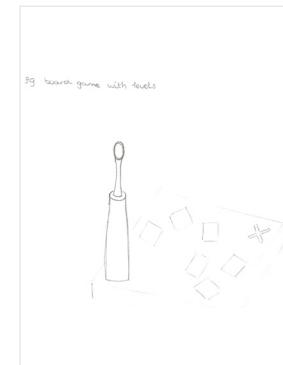


Figure 12: Sketch 39

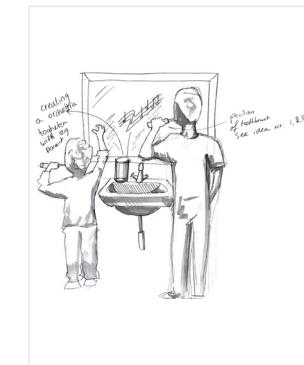


Figure 13: Sketch 15



Figure 14: Sketch 56

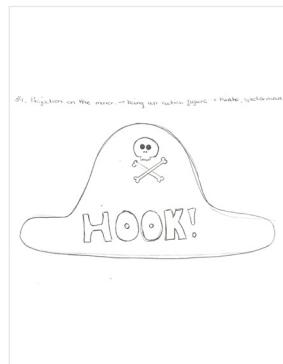


Figure 15: Sketch 34

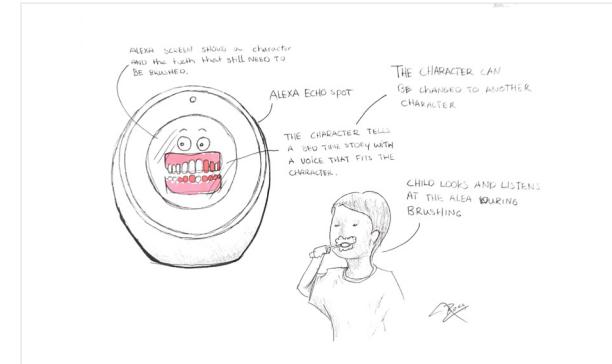


Figure 16: Sketch 11

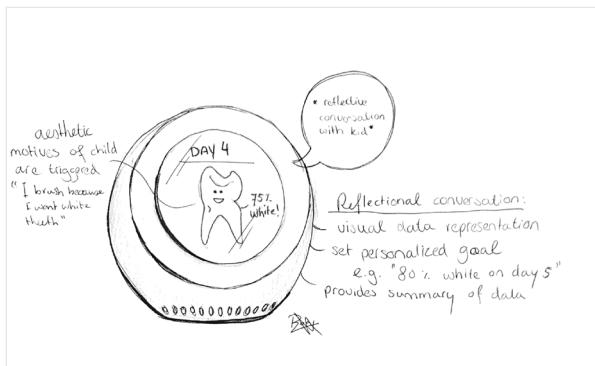


Figure 17: Sketch 10



Figure 18: Sketch 14



Figure 19: Sketch 1

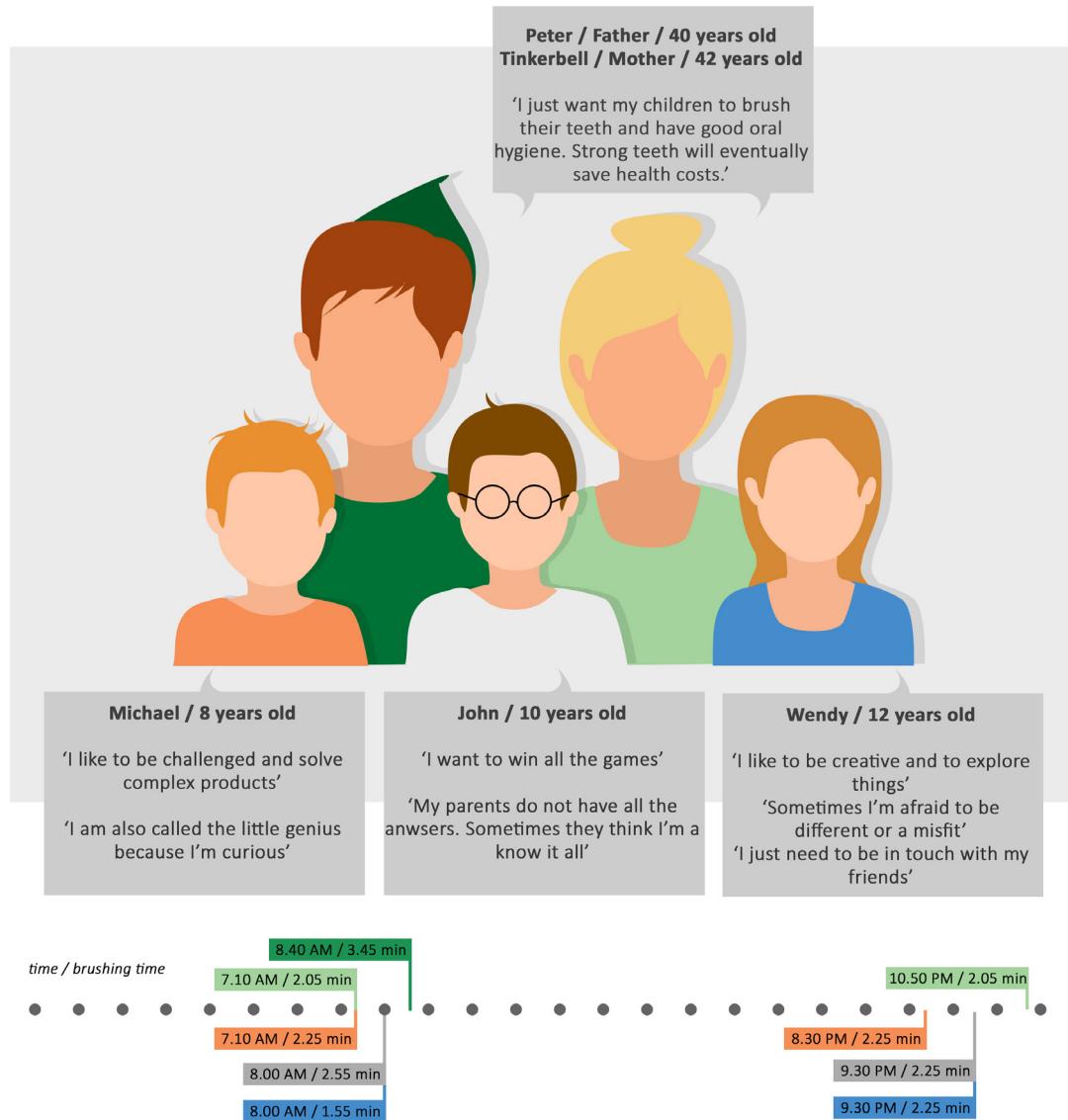
## Family persona

To support the design process, we made a 'family persona'. In order to create an accurate and relevant persona, this family persona is inspired by the related work and data analysis on previous research from our client. The family persona represents the values and needs of the future users, and is completed with an example timeline of the families brushing routines.

## ToothStory, the concept

Based on all the gathered insights on the target group, context and relevant topics, the concept ToothStory was defined. ToothStory is an Alexa skill meant to help improve children's oral health care routines by collaborating within the family. ToothStory is an interactive story that is influenced by choices of all family members. This interactive story regulates the routine and creates a higher quality of brushing by giving feedback and educational hints to the user. It creates an indirect conversation between family members through Alexa by making it possible to collaboratively work on a story, even though you are not listening to the story at the same time.

To clarify the concept, a storyboard and a model of the infrastructure of the skill are presented. It is important to note that this concept can consist of any engaging story fitting to the listener, as long as certain key elements are represented within the story. The story must be interesting to the specific user, allow for exploration, and it must contain educational hints, interesting choices and cliffhangers. These factors contribute to the final goal of engagement in the routine and quality of brushing. The actual interpretation of the story is variable and can be adapted to the interests and needs of the different listeners. Also, the medium or platform on which the story is played does not play a crucial role in the effect of the concept. In the current situation, an Amazon Alexa Echo Spot is used, but this can also be a Google Home, or any other type of voice assistant with which you can interact.



**Figure 20:** Family persona including a timeline of the families brushing routines

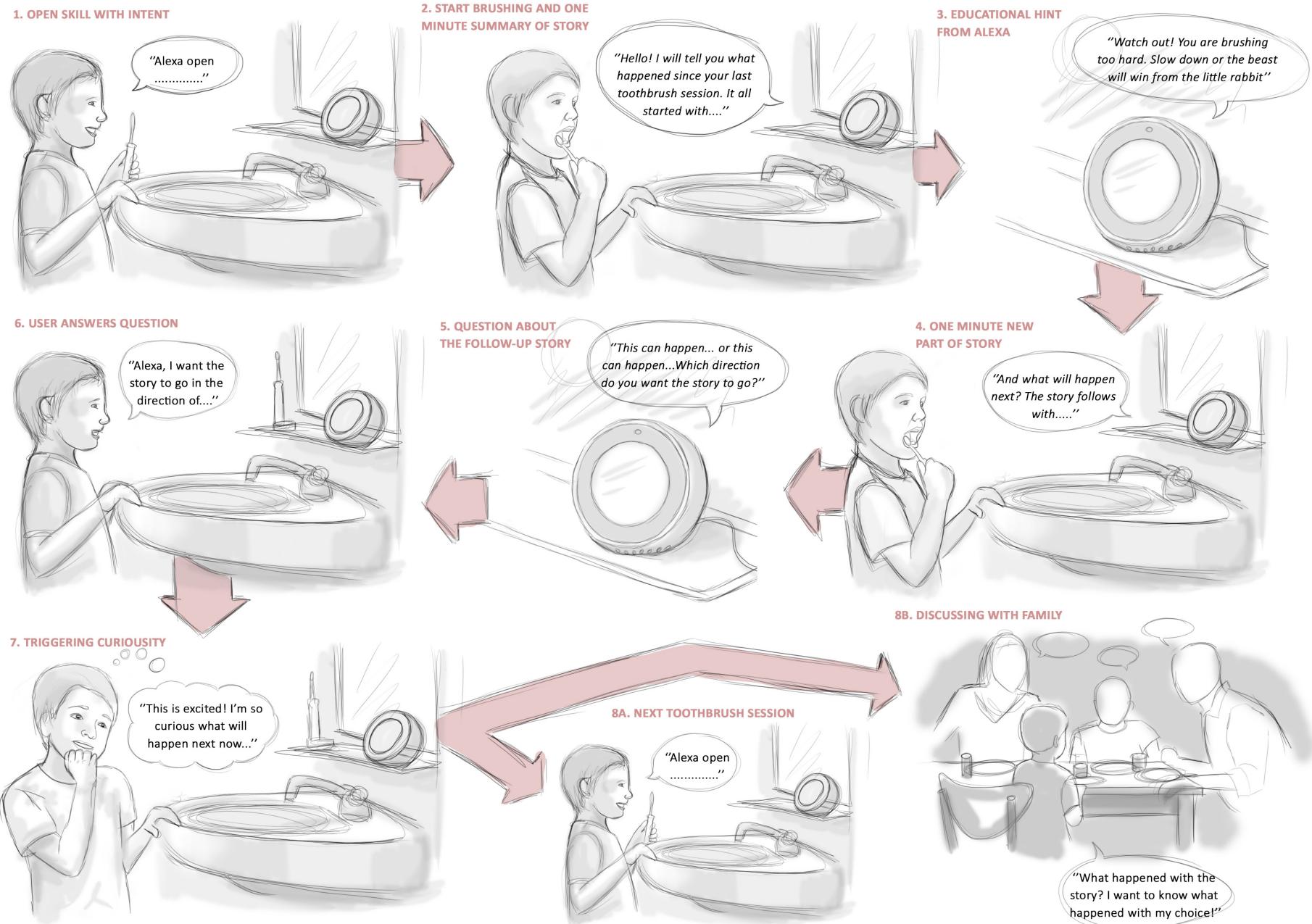


Figure 21: ToothStory storyboard

## Mid-term feedback

During the mid-term we presented the concept and design process in order to get feedback that was used to improve the product. The main point of feedback we received regards the business side of the concept, which needs more attention (quote 1). This means that we need to define a business model for our concept, and we need to think of a way to transfer our concept to the client. Furthermore, we should explore the possibilities further so we can make the concept more concrete, complete and distinctive from competition. This could for instance be done by emphasizing the effect on family dynamics of ToothStory, and by focussing on improving the interaction the family has with the skill. In this way, we emphasize our role as designers, instead of creating a story (quote 2). This interaction needs enrichment because the interaction between the user and the product in the current concept is very limited and simple (quote 3). Integrating more interaction options and creating active participation of the user were suggested solutions that we explored over the course of the project.

Feedback quote 1: "The business model is of utmost importance in this design as the service you give will make or break the success of the product - and continuous stories requires continuous investment and continuous costs for the users parents"

Feedback quote 2: "Fantastic idea, and great video! But... what is the role of designer here? Why can't a philips copywriter just do this? Because the contribution is just engaging text in 2-minute snippets right? What competencies do you actually need here?"

Feedback quote 3: "Right now the video doesn't seem to show any interaction. It seems like it's just a story being told to the user, without active participation (except naming the penguin in the end). In the presentation you showed that if the user brushes too loudly it affects the story (the monster can hear them). Use stuff like that... Make teeth brushing more interactive and fun."

For the next iteration we have to look critically on how to integrate the family dynamics by measuring and quantifying them. This will help to prove that our concept influences the family dynamics.

Another point that needs improvement is enrichment of the storylines (Appendix I) and the interaction. We should go in-depth about the meaning of aesthetics in the context of conversational UI's. To show a more complex understanding of modeling, we should make clear how the multiple dimensions in the storyline relate to family dynamics.

## METHODOLOGY FIRST USER TEST

This chapter addresses the question "What are the user's first impressions and reactions to Family Brush Story". To answer this question, we conducted an exploratory user test at the end of the first iteration. The aim of the user test is to gain insights about the effectiveness of the motivational elements of the skill, as well as the effect the skill has on the family members. The test simulated the functions and experience of Family Brush Story by using a Wizard Of Oz type of solution. The evaluation of the test consisted of an in-depth interview with the users. The research questions we addressed are "How do the motivational elements of the skill (duration, educational hints, question at the end and discussion with family members) improve the personal oral health care routine of the user?", and "What other reactions and activities occur within the family as a result of using the skill?".

### Methodology: participants, material and procedure

The participants of the user test had to meet two requirements: the participants are part of the same household and at least one of the participants is 8 to 12 years old. We were not able to find native English speaking families for this user test. Due to this reason, we broadened our scope and focussed on Dutch families as well. The Dutch family that participated in this first user test consisted of one mother (P3) and two children, a boy of 8 years old (P2) and a girl of 11 years old (P1). Before the started the test, the research was approved by the ethical committee and an informed consent form is used.

Due to this test being influenced by the circumstances of the corona crisis, we decided to make a prototype that could be tested and evaluated remotely. We made a digital prototype that simulated the functions and experience of Family Brush Story. The prototype consisted of mp3 audio files with a Dutch narrative (Appendix III: transcripts mp3 prototypes). The audio files contained a 2 minute story with an educational hint and an ending question that could be answered via a text.

Due to these functions we were able to test the following motivational elements: duration of brushing, educational hints, and the question at the end of the toothbrush session. The audio files are sent to the participants digitally.

For the in-depth interview an interview guide (Appendix IV: interview guide), a mobile phone connection, and recording material is used. The questions of the interview address the motivational elements and other activities that occurred within the family. The interview is structured by an introduction, introductory questions, in-depth questions, and ending questions.

The test consists of three sessions spread out over three days. The provided instructions were limited, because we wanted to explore how the participants would use the prototype without influencing them too much. We did not instruct the participants to brush in the evening or morning, or to brush together or alone. For the first two sessions the mother (P3) received an audio file with the story. P3 is instructed to play the audio once a day when the children (P1 or P2) would start toothbrushing. P1 and P2 listened to the story and followed the instructions during brushing. Next, P1 and P2 answered the question at the end of the story. P3 sent this answer to us digitally. The next day P3 received a follow-up story from us, and so on. During the third, and last session, we conducted interviews. The first interview was conducted with P1 and P3, and lasted for 18 minutes. The second interview was conducted with P2 and P3 and lasted for 7 minutes. This interview was shorter in time, while the younger participant was more shy than its older sister and was less focussed halfway through the interview.

We transcribed the interviews and organized the answers based on the motivational elements: duration, educational hints, question at the end, discussion. By analyzing this data, we are able to see if the motivational elements motivated the users to improve their oral health care routines and what the influence on the family dynamic is. When we organized the data, we divided it in two sections, namely 'improvements' and 'positive feedback'.

## RESULTS

The next steps of the project were to finalize the first prototype and to conduct the first user tests with the target group. Further details about the methodology of the test are described in the chapter 'methodology'. In summary, the aim of the first user test was to gather insights about the functioning of the skill and about the suitability of the skill towards the interests of our target group. For the first user test we decided to make a prototype that could be tested remotely. We created audio files that simulate the experience of ToothStory and send them to the participants digitally. The test was evaluated by an in-depth interview. We analysed the outcomes and formulated points for improvement. Firstly, the interaction that involves the 'moment of choice' needs improvement. All the participants mentioned that it was difficult to remember the provided options. This is especially difficult for the younger children in our target group, because they need to remember the question and, at the same time, need to think about the choice they want to make. Furthermore, the interaction of making a choice could be made richer by adding more choices or by asking open questions.

Quote girl, 11 years old: *"I like two options, but I also like more options. It would be fun to make up a name yourself! Or options with multiple names or something."*

Quote mother: *"At the end of the story I needed to repeat the question. The question is asked and then something more is said. And, after this is said, the children have to answer. It is difficult while the children are still awaiting for what is going to happen. And then, the children are distracted and forget what is said."*

Secondly, the mother mentioned that stories that concern current topics would be interesting to hear for parents. It is interesting for parents to know what their child preferences and opinions are about actual topics.

Quote mother: *"Actual stories about events or something would be interesting for parents. I think, as a parent, you are not excited for a fantasy story. As a parent it is interesting to know what your child is answering. I'm curious about what my children would choose."*

The last point of improvement is that children, if they use ToothStory daily, need more time to prepare their toothbrush when they activate the story. Besides these points of improvements, we gathered some confirmations about the functionalities of ToothStory as well. The outcomes confirmed that ToothStory helps to motivate the children to improve their oral healthcare. The cliffhangers and the educational hints positively influence children to brush properly. The cliffhangers will make children speculate and question whatever will happen next in the story. The educational hints are experienced as fun and helps them to create awareness about brushing their teeth properly. Furthermore, the story itself helps children to make brushing fun because children are 'doing something', namely listening to the story. Also the story is exciting which means children do not want to stop till the story ends. Lastly, it is confirmed that discussions between family members occur as a result of using ToothStory. The participants evaluated the story with the other family members and asked about what other members chose.

## Iteration two

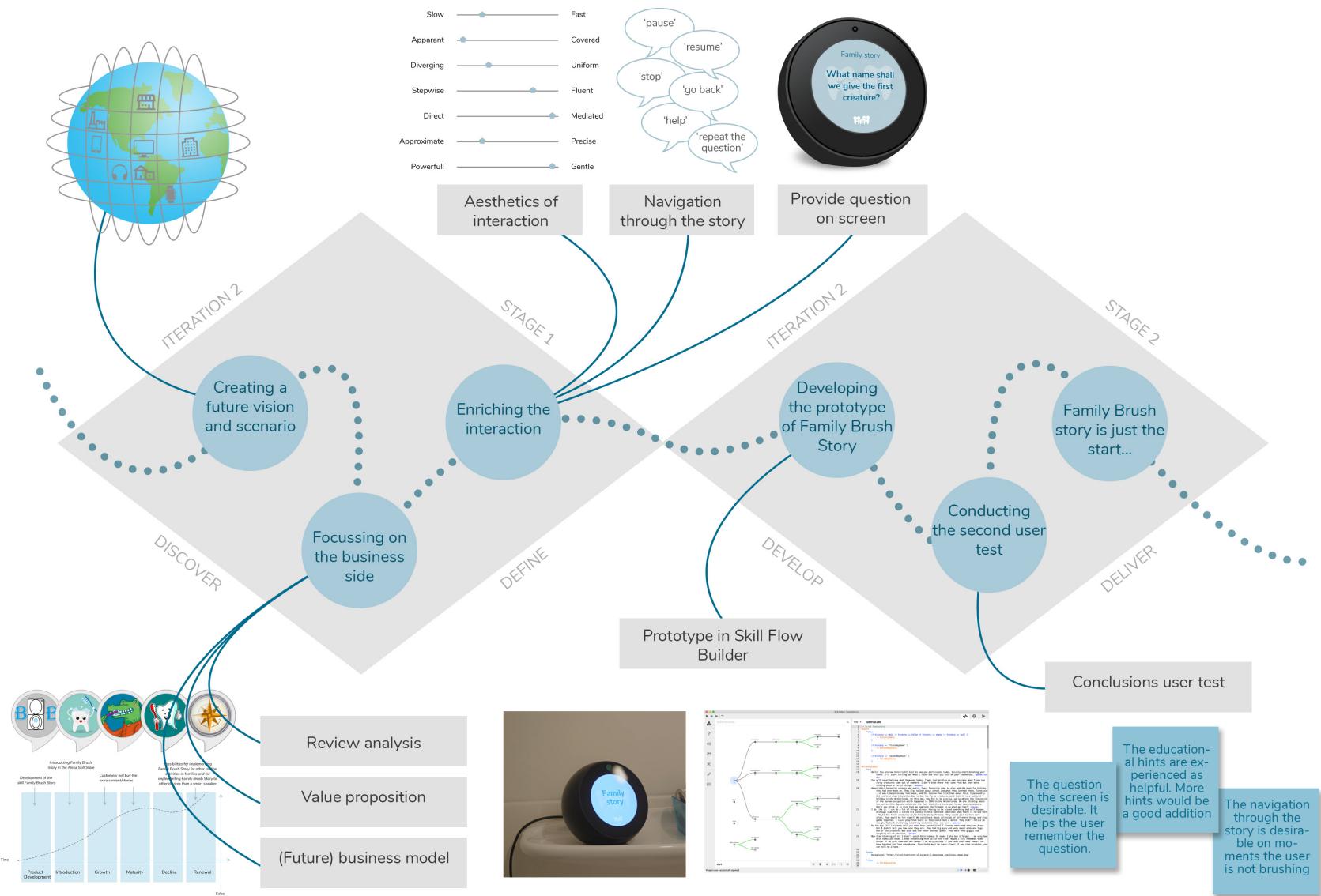


Figure 22: Design process iteration two

## Additional benchmark

During the mid-term we received feedback about the benchmark. One of the tips we received was to look at the reviews of other related Alexa skills to collect high quality data. We conducted a review analysis on different skills, namely Chompers, Toothbrush Time With Fun and Music, Toothbrush Timer, and Choose Your Own Adventure (Appendix V: table review analysis). From the review analysis we conclude that: we can make parents more interested in the skill if the children go brushing without arguing, if the story is fun to hear for the parents as well, and if the skill also improves the oral health care for the parents. Furthermore, the name of the skill should be easy to pronounce. The skill name should not consist of any names or sound similar to existing skills. And lastly, it is important to give children freedom to choose the things they like, but don't provide too many choices in a skill. Children can't remember the name of a song or story that they liked or disliked.

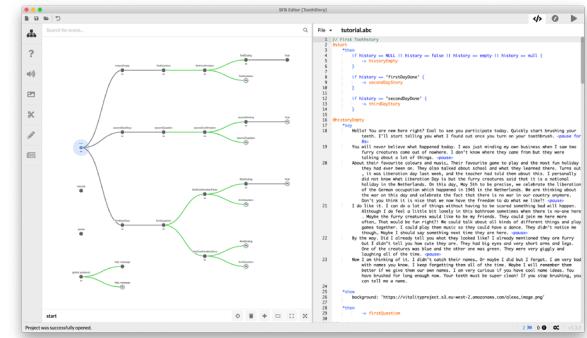
## Developing ToothStory, the prototype

The prototype of the second iteration was created using Skill Flow Builder. Skill Flow Builder is an Amazon Alexa tool that makes creating story-based and game skills easier. The branching storylines are displayed on the left of the screen and the code can be found on the right (Figure 23). This visual representation makes it easier to keep track of the story, the variables, the interaction modules and the structure that goes behind the story. The base syntax (Figure 24) is simple to write and understand and more complicated elements are documented in the Skill Flow Builder Reference.

Even though Skill Flow Builder is meant to help less technical skill collaborators, installing Skill Flow Builder required quite some technical skills and knowledge about the Amazon system. Appendix VI shows all of the components involved and the structure that connects all of the components. Appendix VII shows how the components communicate when deploying the skill from the Skill Flow Builder environment to the Alexa Developer Console and other Amazon systems. Although setting up Skill Flow Builder and deploying the skill using the terminal can be quite complex, Skill Flow Builder itself is intuitive and helpful when building story-based and game skills. Therefore, using such a system can be highly recommended when cooperation is needed between story writers and developers.

There were two focus points for this prototype. The first one being creating storylines (Figure 25) and branches to this story that are based on the input of the user. The second focus point being the interaction with the skill. This interaction is essential because it helps children to control the skill, for instance by pausing the story or by asking Alexa to repeat the question at the end of the toothbrushing session if needed. We started building the skill by writing a story and implementing this in Skill Flow Builder. We took a few important notes from the previous iteration into account when writing this story. Firstly, we mentioned Liberation Day, to keep the story current and to teach children something without it being too obvious. This was requested by a parent that gave feedback on the first iteration of the concept. This participant mentioned that it would be interesting to get input of children to current events. We also made sure that it really felt like Alexa was a person telling a story, which is meant to help with personification and thus engagement with the product and skill. Lastly, we added more open questions, based on feedback we got on the first iteration.

The process of inserting stories is easy and effortless using the Amazon tool. However, some difficulties quickly arose as we tried to implement more complex features. Using multiple of the same type of variable caused bugs in the skill and saving input to a database proved to be more complicated than anticipated. We also found that Alexa didn't understand the name ToothStory, which was the name of our concept and the invocation name of our skill. Alexa interpreted 'ToothStory' as 'tooth fairy' or didn't know what to do at all, causing us to change the name of our skill from ToothStory to 'Family Brush Story'. Alexa understands this invocation, doesn't confuse the skill with other skills and the name suits our target group well, since children are very likely to be able to pronounce this name clearly.



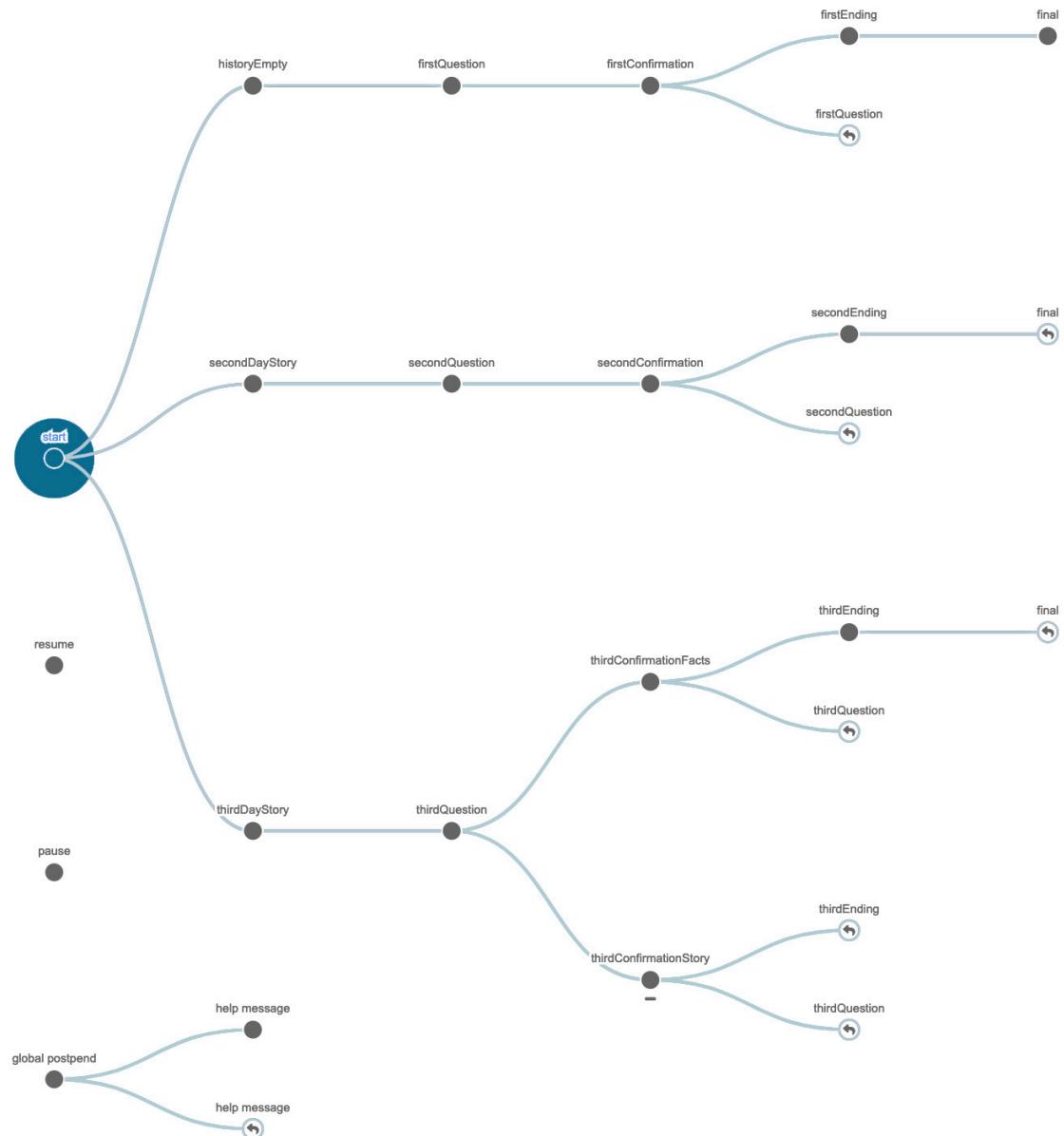
**Figure 23:** Skill Flow Builder Interface

15  
16 @historyEmpty  
17 \*say  
18 | Hello! You are new here right? Cool to see you participate today. Quickl  
teeth. I'll start telling you what I found out once you turn on your  
8s>  
19 | You will never believe what happened today. I was just minding my own bu  
furry creatures come out of nowhere. I don't know where they came fr  
talking about a lot of things. <pause>  
20 | About their favourite colours and music. Their favourite game to play an  
they had ever been on. They also talked about school and what they l  
, it was Liberation day last week, and the teacher had told them abo  
did not know what Liberation Day is but the furry creatures said tha  
holiday in the Netherlands. On this day, May 5th to be precise, we c  
of the German occupation which happened in 1945 in the Netherlands.  
the war on this day and celebrate the fact that there is no war in o  
Don't you think it is nice that we now have the freedom to do what w  
21 | I do like it. I can do a lot of things without having to be scared somet  
Although I do feel a little bit lonely in this bathroom sometimes wh  
. Maybe the furry creatures would like to be my friends. They could  
often.. That would be fun right?! We could talk about all kinds of di  
games together. I could play them music so they could have a dance.  
though... Maybe I should say something next time they are here. <pause>  
22 | By the way. Did I already tell you what they looked like? I already ment  
but I didn't tell you how cute they are. They had big eyes and very  
One of the creatures was blue and the other one was green. They were  
laughing all of the time. <pause>  
23 | Now I am thinking of it. I didn't catch their names.. Or maybe I did but  
with names you know. I keep forgetting them all of the time. Maybe I  
better if we give them our own names. I am very curious if you have  
have brushed for long enough now. Your teeth must be super clean! If  
can tell me a name.  
24  
25 \*show  
26 background: 'https://vitalityproject.s3.eu-west-2.amazonaws.com/alexa\_im  
27  
28 \*then  
29 | -> firstQuestion  
30  
31 @FirstQuestion  
32 \*say  
33 | What name shall we give the first creature?  
34  
35 \*show  
36 background: 'https://vitalityproject.s3.eu-west-2.amazonaws.com/alexa\_im  
37  
38 \*then  
39 slot firstCreatureName as 'AMAZON.FirstName'  
40 hear let's name it {firstCreatureName}, {firstCreatureName}, call it {fi  
41 | -> firstConfirmation  
42 }  
43  
44 \*reprompt

**Figure 24:** Skill Flow Builder syntax example

The major part of the building process of the skill was spent on getting the database to function correctly. Getting Alexa to tell multiple stories with several variables in one go wasn't a problem. However, getting Alexa to store the user's input over the course of multiple days was more difficult. Within this prototype, we solved this problem by adding a variable that is updated once a user completes a toothbrushing session, including answering the question at the end of the story. With this variable, we were able to keep track of the user's progress by pulling the variables value and by pushing an updated value to the same variable slot at the end of a follow-up session.

We decided to implement more interaction in the skill based on the feedback on the first iteration. This included the following navigation actions: pause, resume, stop, go back, help and repeat the question. A few of these actions are automatically handled by Alexa intents. Some of the actions like 'repeat the question' needed to be implemented manually using Skill Flow Builder. The reprompt function helps with this, as it repeats any given text if the user doesn't give input when asked. We also included visuals that can be displayed on the screen of the Alexa Echo Spot. This is an extra feature that won't work on voice assistants without a screen, but can be very helpful to help users keep track of what is happening or expected from them. The visuals used in the prototype contained the name of the skill when the story was told, and presented the question in text form on the screen when Alexa asked for input.



**Figure 25:** Family Brush Story branching storylines

## SECOND USER TEST

The prototype built in Skill Flow Builder was meant to test interaction possibilities between the user and the Alexa skill. The research question was therefore: "How do users experience the interaction possibilities with the Alexa skill Family Brush Story?". We also gained insights on other topics such as family dynamics and customer's interests. To test our prototype, we set up a deployment research for the duration of three toothbrushing sessions with four users. The users were able to test the skill without the interference of the researchers. Users were able to evoke the skill, listen to the story and answer the questions of the Alexa skill themselves. The researchers used the unstructured observation method to see the actions, reactions and interactions of the users with the skill. Interviews were conducted after the last day of deployment which resulted in useful insights to be used for further improvements of the product.

### Methodology: participants, material and procedure

Because this test evolved around the interaction with the skill rather than the relevance of the story and due to the constraints that come with user testing with children, we chose to test our prototype with adults based on convenience sampling. We tested with four adults, that are all brushing with an electric toothbrush and are capable of understanding and speaking English, which was needed for this English oriented prototype. There were no further selection criteria in this case. Within this test, users were equipped with a phone on which the Alexa app was installed. Users could evoke and interact with the skill through this app. A limitation of this app was the impossibility to show the background visuals that would have been visible on the actual Alexa Echo Spot. The researchers therefore showed the visuals in the interview, to still get feedback on this feature. This restriction did however also give us information on the necessity of the screen, as it gave us insights on how important this element was in providing a good usability.

As mentioned, this user test consisted of unstructured observations over a time span of one and a half days

and interviews that were conducted after the users finished the third toothbrushing session accompanied by the prototype.

### Results

One participant only tested the Alexa skill individually. The other participants tested the skill collectively and at the same time while brushing teeth together. One participant did not have enough time to prepare his toothbrush with toothpaste due to an empty toothpaste bottle. All participants were laughing during the story and at the time of Alexa's question, but laughing seemed uncomfortable during brushing. The participants that brushed together were having fun while at the same time being seemingly distracted from the story. The educational hint that was implemented in the story were followed up by the users. Nevertheless, the positive change in brushing quality only lasted for 10 seconds, after which the participants went back to their regular brushing behaviour. Some of the users seemed confused when the subjects within the story changed, as if they did not understand the link between the topics. All users gave the answers to the questions at the end of each session quickly, without needing to think or needing a reminder of the question by Alexa. The participants of the joint toothbrushing session did not use the interaction options such as pause, resume or reprompt. They could however imagine this to be useful in some cases. One user constantly tried another word to confirm his answer at the end of the story, while the other users just said "yes" as confirmation.

Participants mentioned that the skill provided them with awareness of the recommended brushing time of two minutes. They stated that they found the story to be finished quickly, although they were questioning whether children would be able to stay focused on the story the whole time. Participants brought up the desire for more educational hints. They wanted to know where to brush and how to brush. "If I am a child, I can easily keep my toothbrush in the same place which wouldn't make any difference to my dental hygiene." All participants that brushed jointly agreed that it was nice that they were able to interact with the Alexa by making a certain motion with the

toothbrush. They were aware that this was meant as an educational hint and they stated that they would like more of this type of hints that are incorporated in the story and interaction. The screen could also help with this according to the participants. "Maybe you can connect zones in the mouth to collars on the Alexa. Green is the upper left, blue is the bottom right etcetera. So the story can continue while I am getting hints at the same time." The participants didn't feel the need to interact with the Alexa further, besides the educational hint and the question at the end; meaning that they didn't want to pause, stop, rewind etcetera.

Two of the participants are parents of two children. They stated that this would be very interesting to help young children without needing their parents. "I think there are a lot of parents making up stories and helping their children brush correctly at this moment. A product like this would help make this ritual easier and more attractive for children. I like this type of gadget so I would definitely consider buying such a product."

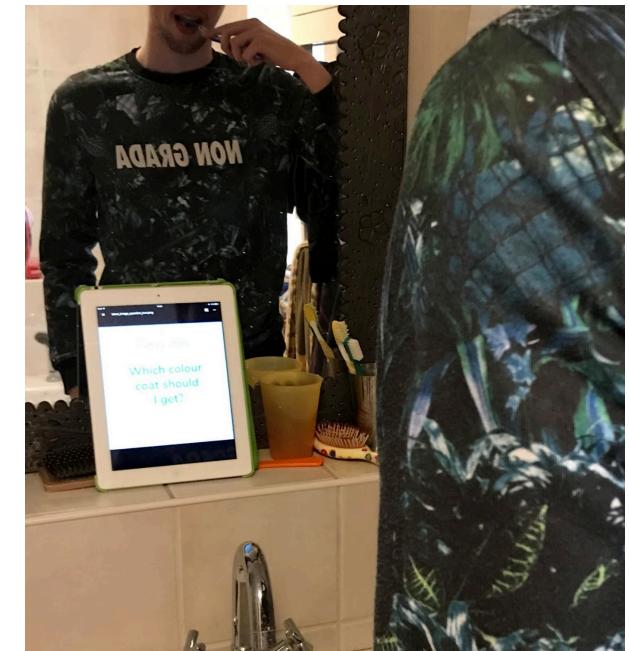


Figure 26: Second user test set up

## DISCUSSION

From this study can be concluded that the interaction with Family Brush Story works well. Users can start and communicate with the Alexa skill without needing further assistance or guidance. The participants weren't interested in interactions like pause, stop, resume and repeat but did mention they could imagine these options being useful in some cases. Further research should show how children react in this scenario, and if they would be interested in the interactions. If they are, the interactions should be further developed to work properly and in a user friendly way.

The most important insights from the second user test were about the educational hints within the story. Participants stated that they want a lot more of these hints during the entire tooth brushing session. The way educational hints can be given and combined with other modalities should therefore be explored in future research. Possible directions to explore are "hints via the screen", "hints in between the story" and "hints incorporated within the story". A combination of two or more of those could also result in interesting solutions.

During this user test, a few of the participants had a joint toothbrushing session. This joint session showed that family members were having fun together, but were also distracted from the story. This did however not obstruct them from keeping up with the story and answering the question at the end quickly. Further research should be conducted to gain more insights on the effect of Family Brush Story on families in general, and the family dynamics in specific.

A topic that arose unintentionally during this user test was the role of the parent in relation to the toothbrushing habits and routines of the child. Participants found Family Brush Story very interesting as it would help parents to teach children how to brush correctly without having a big struggle, since the skill will make toothbrushing a more fun activity. This confirms statements made earlier, and strengthens the argument that the Family Brush Story skill is highly relevant for both children and parents.

Besides further research that should be done, the functionalities of the Alexa should be further developed to facilitate all potential features of the concept. Since the technology behind voice assistants is relatively new and innovative, there are quite a few problems that are encountered when developing skills. This has a strong

influence on the use of and the user-friendliness of the product. This project for example showed that in the current version of Alexa, it is very difficult to work with multiple open variables of the same type. Having two of the same open variables causes errors in the skill, making you jump within the story instead of following the storyline as intended. This is just one example of the multiple difficulties that can be encountered when working with the Alexa. These problems should be considered and redesigned and the technology should be updated so skills can be made without any technical constraints that withhold concepts from living up to their full potential.

In addition to the technical aspect, the context in which the voice assistant is placed is playing a huge role in the functioning and success of Alexa skills. The context plays an essential role in the user experience as the product only has a few ways of communicating with the user. In this project, the device used had a screen, while the majority of voice assistants does not have a screen. This means that the only way of interacting with the voice assistant is through voice input and output as its name suggests. This causes problems in some cases, for instance when there is a lot of background noise or when a child's articulation isn't clear enough for the device to understand. Considering and mapping out all limitations like this example in different scenarios is key to designing a user friendly, efficient and effective skill.

## CONCLUSION

In this report, we presented the design process of an artefact that improves the oral health care routines of children by using voice assistant technology. Dental caries is the most common chronic disease amongst children. There are a lot of negative effects coming from bad dental hygiene, but fortunately this can be prevented by brushing properly and maintaining a consistent routine. While research shows that routine and family dynamics influence each other, voice assistants can help to prevent dental caries because they are more and more integrated into family's homes and contribute to family bonding. Family Brush Story is a voice assistant application that uses interactive storytelling to help children to maintain a consistent routine and to positively influence the family dynamics.

Within this project, we have conducted exploratory design research to find the main difficulties that occur and the opportunities that we can utilize to help children and their parents to improve their tooth brushing habits. This was all done within the scope of US based children between eight and twelve year old, that have access to an Amazon Alexa within their homes.

Because of the nature of this research, and the early stages of the product development, further research is needed to answer new or unanswered questions, and to improve the project result to get it to a production worthy state. Although our design process showed that the current voice assistant technology has technical limitations, the future of the voice assistant technology can be seen as promising. If we take it a step further: imagine a world in which child care has been taken over by voice assistants. Tying shoelaces, eating vegetables during dinner, or going to bed at a decent time are no longer parent's concerns. Family Brush Story takes away parents concerns by supporting children in improving their oral health care routines. Is Family Brush Story the first step towards a world in which child care has been taken over by voice assistants?

## PERSONAL REFLECTIONS

### Rooske van Loon

#### Integration of Expertise Areas (EA's)

In the beginning of the project we integrated the EA of User & Society by conducting literature research to the target group and by interviewing our client/expert. This interview provided us useful information about the target group and helped to create a focus in the project, namely family dynamics and routine. Later in the project we conducted the first user tests. While I never interviewed children before, I managed to figure out how to conduct these interviews to gather useful information for the project.

Although we did not make a physical artefact, we managed to integrate the EA Creativity & Aesthetics in the project. The integration can be seen in the sketching challenge and the storylines. During the second iteration, we focused on the aesthetics of the interaction. Our aim was to create richness in the interaction to create a pleasant user experience.

The integration of the EA Technology & Realization can be seen in the prototypes. Making a working prototype with the Alexa was challenging. Due to the obstacles we experienced in the beginning, we decided to create a simple prototype of MP3 files. This helped us to test the concept with the target group. We wanted the second prototype to work on the Alexa and to be able to simulate the experience realistically. The higher quality allowed us to test the interaction properly. Although wasn't possible to test with the target group again, we were able to generate new insights and improve our final design.

We integrated the EA of Creativity & Aesthetics by showing a high level of complexity within the storylines. At first sight the story of the concept seems simple. Nevertheless the storylines have a complex structure while every decision of the user affects the story. Our solution was to create variables in the storylines. This means that the basic storyline stays the same but certain parts in the story change according to these variables.

We integrated the EA of Business & Entrepreneurship during the second iteration. We described the stakeholders and product life cycle of our concept and created a value proposition and (future) business

model. The future vision and scenario helped us to create a business model that could be sustainable for the longer term. A missed opportunity is that we did a limited benchmark and mainly focused on the information our client and the literature research in the beginning of the project. If we expanded the benchmark more in the beginning, we would have evaluated our concept more critically.

#### Professional skills and further learning

In the beginning of the project, we worked on project activities at the planned project time in the squad place. Communicating and sharing ideas worked well this way. Anika and I have different backgrounds, thus we have different perspectives on topics. This lead to a motivated and inspired atmosphere within the group because we learned from each other's knowledge and skills. Due to the corona crisis, this situation slightly changed. I soon noticed that the digital communication makes it harder to create a coherent project and motivate each other. During digital meetings we reflected on the progress of the project, informed each other about the individual activities, shared ideas and decided on the next steps we would take. Thus we were still able to create cohesion in the project. On one hand, I learned that digital communication is very efficient and flexible. On the other hand, it is obstructs creativity, motivation and coherence within a project. Nevertheless, this taught me that sharing ideas and keeping each other informed are key when communicating digital.

We conducted most of the activities together, but some aspects had to be divided due to this situation. While Anika focused more on the technical aspect, I focused more on the business aspect. It is important to mention that all of these activities were discussed and evaluated together during digital meetings.

While I did multiple projects with sounds and acoustics during my bachelor, I developed an interest in interactions with sound. My first personal learning goal was to explore theories and tools that help me to design an artefact that involves interactions with sound. During the project I did literature research to conversational user interfaces, in particular to VUI's. I used this knowledge during the user test and evaluations. The most important aspect I learned is that sound can enrich an interaction by making it more human like, but a VUI has limitations. During my further master program I want to explore what

sort of interfaces can be combined with sound to make the most out of the benefits. My second goals was to design an artefact that blends into the daily life by doing research in psychology. I want to design products that are close to me; products that participate in the daily life of people but also take the complete context of the user into account. During the project we conducted literature research and user tests to gather insights on the behavior and routines of our target group to create a suitable UX. A missed opportunity here, is that we were not able to test with families for the long term. This would have helped us to gather more insights on the influence of our concept on the family dynamics. In my further master program I want to dive deeper into the psychology of the user and be able to test my insights instead of making assumptions. While the future is an important aspect of my PDP, my third goal was to learn methods how to design an artefact that takes the future context of the artefact into account. Therefore I created a future vison and scenario concerning our concept. I used methods of a course I'm following, Researching the Future Everyday. Using these methods fits the EA's I want to focus on during my further master program, namely User & Society and Creativity & Aesthetics.

## Anika Kok

### Integration of Expertise Areas (EA's)

During this project, Rooske and I have worked hard to cover a wide variety of topics and activities while covering the expertise areas of Industrial Design. We started off by sketching and conducting literature research to dive into relevant topics and to generate ideas to proceed with. Rooske is very good at visualising her ideas by sketching and making diagrams. This made me realise that I can improve my skills in that area, because it helps communicating ideas from early stages onwards.

Careful consideration of user testing with children was needed within this project. To do this as efficient as possible, I read information on how to design for and work with children. I also asked for feedback on our plans and consent forms to experts in the field. Besides the fact that testing with children is different than with adults, the COVID-19 situation was also contributing to having to rethink user testing in such a way that it would still provide useful insights for the project. I believe that one would need to work with children way more often to get a feeling of how to speak their language and design for them, although I do think it went really well in this case.

The majority of my time for this project has been spent on creating the final prototype. I first started testing both the Alexa developer environment and Google Dialogflow after which the client advised us to work with the Alexa. During this project, I have worked really hard on getting to know the way Alexa skills work. The structures, systems and code can be very complex and intimidating, which is why I decided to use Skill Flow Builder. This has been a huge game changer in our project, as it allowed us to create solid prototypes that actually worked and felt like a real skill.

What I really liked about this project is working within a specific scope, for a client. I feel like it gives more direction from the start which allows you to spend more time on the actual concept and development. The communication with the client went well and it provided us with valuable input and feedback that we could use to improve our concept. However, next time, I would take more time to carefully research the client and consider their values and vision to create a fitting solution.

### Professional skills and further learning

I am personally very happy with the process and result of this project. I enjoyed working with Rooske as I feel like we push each other to aim for the best. We have some of the same interests and are able to ask each other critical questions to make sure we are not making unjustified assumptions or conclusions. Despite the adapted situation due to COVID-19, we communicated regularly via Slack and video calls. I think that working individually makes you less prone to learn new skills from each other and makes you work on things you already have experience with. I nevertheless feel like I have levelled up in many ways. I am starting to find my way around the academic way of working and writing, which includes doing proper literature research. Because both Rooske and I are very interested in theory, we spent a lot of time reading and researching papers, books, articles and other available information from experts in the field. This kick-off to the project made all the difference for me, as I was way more informed on the topic from the start than with most projects I worked on previously. By sketching a ton of different ideas and by combining these with the knowledge we gained in parallel, we were able to make conscious decisions from day one.

Besides diving deeper into the theoretical side of things, I set a goal of iterating more often at the beginning of the semester. I am a true perfectionist that wants to leave user testing to the last minute when everything feels finished and good to go, even though I know this isn't the best for the product. My goal was 'to make at least two iterations of the product I am designing to be able to deliver an advice for a third version at the end of the semester.' I almost fell into the same pitfall again during this project, meaning I wanted to perfect everything and felt user testing as a major threshold to get over. Due to the coaching within the squad, and the input from my team member, I realised that user testing was the best step to take at that point within the project. We made a low key prototype that was easy to make but would already provide us with lots of interesting insights that we were able to use over the further course of our project.

The second time we needed to user test, I still didn't feel like our prototype was ready to test with users, but I didn't hesitate to do so anyway because of time pressure and the need for input. I realise this is only a one time encounter with not feeling the urge to

postpone user testing in order to perfect elements, but I will keep working on pushing myself to talk to the target group and get feedback on my ideas and products.

During this semester, I have defined my professional identity and vision better and more concrete. I found my passion for 'calm design' and am very eager to learn more about this topic. My plan was to do so during this semester but I unfortunately didn't put as much energy into this as I would have liked to. I didn't manage to complete the personal goal of mine as defined in my PDP. I am still looking for my personal, clear and concrete definition of calm design which is something to work on. However: I have obtained the book 'Calm Technology' as a starting point of my literature research on this topic. Besides that, I have found a coach and a project that fit the topic well, which means I will get to fully focus on calm design from next semester.

## **ACKNOWLEDGEMENTS**

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## **APPENDICES**

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- Appendix II: the three domains and their unusual qualities
- Appendix III: Transcripts mp3 prototypes
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- Appendix VI: Amazon Alexa Skill system components
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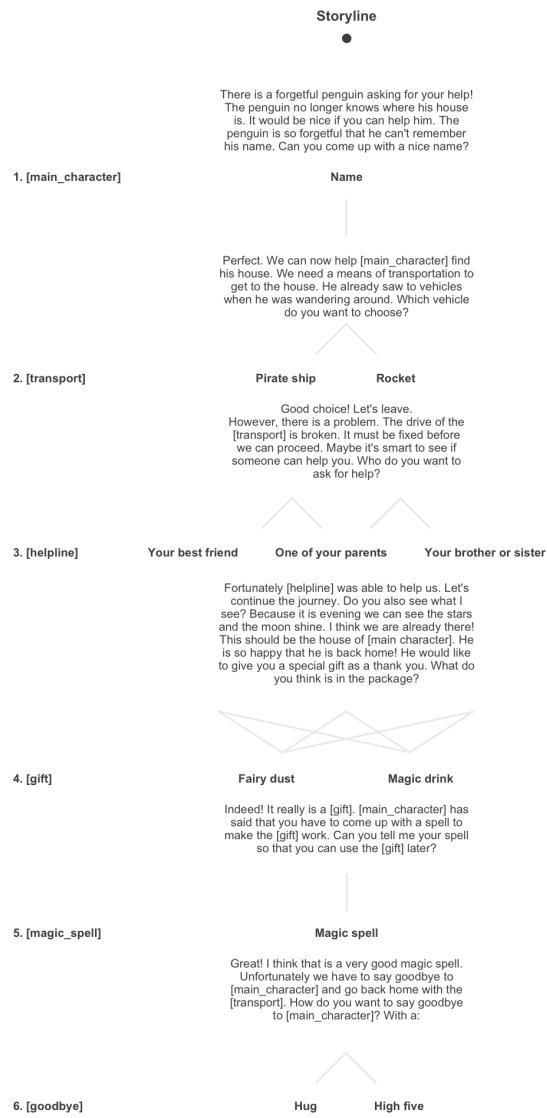
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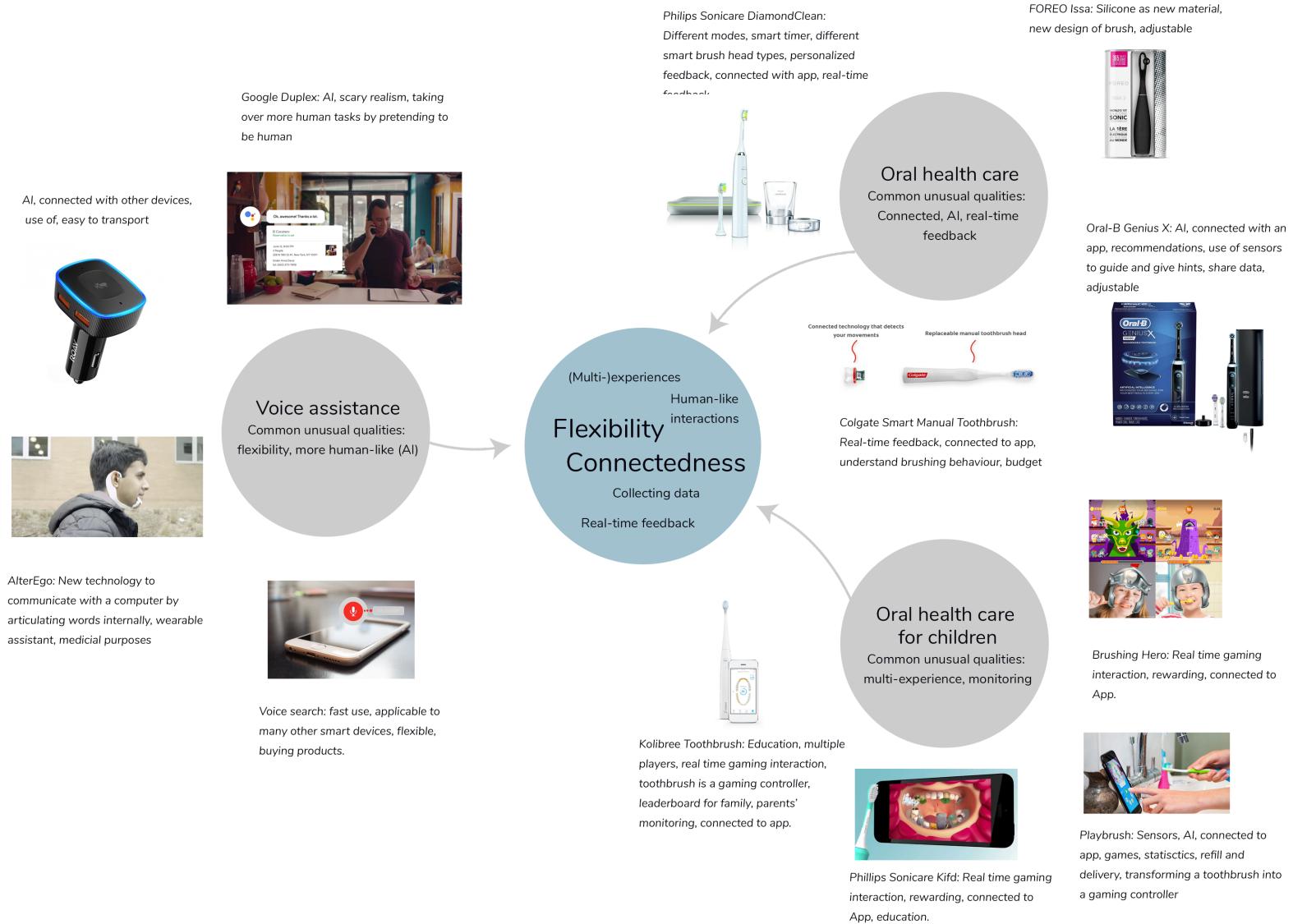
## APPENDICES

### Appendix I: Example storyline ToothStory

#### Going on an adventure



## Appendix II: the three domains and their unusual qualities



## Appendix III: Transcripts mp3 prototypes

### 'Going on a journey together'

#### The beginning: [name main character]

(storyteller) Hello, here you are again! Before we start with the story, can you tell me your name?

(user) I'm [username]

(storyteller) It's so nice to speak to you again [username]! Quickly start brushing your teeth, then we will start with the story. Imagine, you are wandering around in a beautiful forest. Every now and then a sunbeam falls through the trees, illuminating small leaves and branches on the ground. There is still bit of snow here and there. You feel a fresh breeze blowing through your hair. It seems winter has just ended and spring slowly blossoms. (- soft rustle -) You look to the left and see a bunny. It doesn't see you. The bunny quietly nibbles on a blade of grass that rises above the snow. Suddenly its ears go up. Its eyes expand. And... it's gone. The bunny must have seen you. You walk on further. What a lovely walk, you think. You don't have a purpose, except to enjoy nature ... (- sound of branch falling to the ground -) ... You are shocked. What was that! Something white is coming towards you from the bushes. You are squeezing your eyes, but you can't see what it is. What is it? A bear? A monster? You want to turn around. Get out of here! Just when you want to run away, you hear a cry for help very softly from the bushes (- main character says help, help -). You stop because it doesn't sound dangerous. It asks for help. Maybe you can help? You slowly come closer to the bush and push aside some stinging branches. What is hidden there? You don't believe your eyes. It's a penguin!

(main character in story) Please, help me! I think I fell out of the tree. Where am I? I need to go home! Who are you? Wait...actually, who am I? Do you know my name?

(storyteller) The penguin forgot his name. What do you think is a good name for the confused penguin? You can stop brushing your teeth and tell me a name for the penguin.

#### Follow-up 1: [transport]

(storyteller) Hello, here you are again! Before we start with the story, can you tell me your name?

(user) I'm [username]

(storyteller) It's so nice to speak to you again [username]! Quickly start brushing your teeth, then we will start with the story. I'll tell you what happened. You are walking in the fairytale forest. There are sunbeams shining through the trees and there is still a bit of snow here and there. It seems winter has just ended and spring slowly blossoms. Suddenly you hear a branch falling out of the tree. You are shocked. What was that! Just when you want to run away, you hear a cry for help very softly from the bushes (- main character says help, help -). Slowly you come closer to the bush and push aside some stinging branches. It's a penguin! The penguin fell out of the tree and doesn't remember its name. You call the penguin [name main character].

[name main character] looks scared. You walk towards him. [name main character] got scared and shrinks back. Slowly! Do not brush your teeth with too much pressure, you will scare the penguin. [name main character] seems to calm down. You can calmly walk towards the penguin. [name main character] begins to tell his story.

(main character in story) I think I fell out of the tree and lost my memory. I'm so confused. All I know is that I have to go home quickly! I live in the igloo on the north side of the fairytale forest. From the top of the tree I saw a rocket ship and a pirate ship. Can you help me find my house?

(storyteller) Ofcourse you will help [name main character]! The north side of the fairytale forest is far away. You'll need transport. Do you want to choose the pirate ship or the rocket ship? You can stop brushing your teeth and tell me which transport you want to choose.

#### Follow-up 1: [help]

(storyteller) Hello, here you are again! Before we start with the story, can you tell me your name?

(user) I'm [username]

(storyteller) It's so nice to speak to you again [username]! Quickly start brushing your teeth, then we will start with the story. I'll tell you what happened. You are walking in the fairytale forest. Suddenly you hear a branch falling out of the tree (- sound of falling branch -)...Just when you want to run away, you hear a cry for help very softly from the bushes (- main character says help, help -). Slowly you come closer to the bush and push aside some stinging branches. It's a penguin! The penguin fell out of the tree and doesn't remember its name. You call the penguin [name main character]. [name main character] asks for your help. He has to go home quickly, but doesn't its way back. [naam hoofdpersoon] lives in the igloo on the north side of the fairytale forest. That is far away! Luckily, there is a [transport] further on. You walk towards it.

Once you arrived at the [transport], you and [name main character] go inside. You try to start the motor (- weird technical sound -). That doesn't sound good...

The motor is broken! The gears in the motor must rotate. Rotate in small circles with the toothbrush in your mouth to get the gears going...The motor starts, but still, the [transport] isn't driving. Before you can bring [name main character] back home, the [transport] should work. Maybe someone can help you fix the [transport]? Your best friend is super smart, but your parents often give you good advise. Or maybe your creative brother or sister? From which of these people would you like to ask for help? You can stop brushing your teeth and choose a person that can help you fix the [transport].

## **Appendix IV: Interview guide**

### **Introduction**

Interviewer provides an introduction about the project and the interview. The interviewer will mention that the interview is being recorded and will ask for permission.

### **Introductory questions**

- 1.1. What did you think about the story?
- 1.2. Did you listen the the whole story being told during brushing?
- 1.3. How long did you think the toothbrushing lasted?

### **In-depth questions**

#### *Questions about the educational hints*

- 2.1. Did you hear the hints in the story? If yes:
  - 2.1.1. What did you think about these hints in the story?
  - 2.1.2. Did you understand the hints?
  - 2.1.3. Did you brush differently after listening to the hint?

#### *Questions about the question at the end of the toothbrush session*

*Interviewer explains: At the end of the story, a question was asked. For example if you want to choose the pirate ship or the rocket ship.*

- 3.1. What did you think about these questions at the end of the story?
- 3.2. How did it feel to answer this question?
- 3.3. Were you curious about the next story? Why?

#### *Questions about any other activities that occurred within the family*

- 4.1. Did you discuss the story with each other afterwards? If yes:
  - 4.1.1. What did you talk about?
  - 4.1.2. How did you feel about this?

### *Extra questions for the parents*

- 5.1 Have you also listened to the story? If yes:
  - 5.1.1 What did you think of it?
  - 5.1.2. Would you also be interested in using it? If yes:
    - 5.1.2.1 In what way?
    - 5.1.3. Would you buy it for your family? If yes:
      - 5.1.3.1. Way would you consider to buy it?

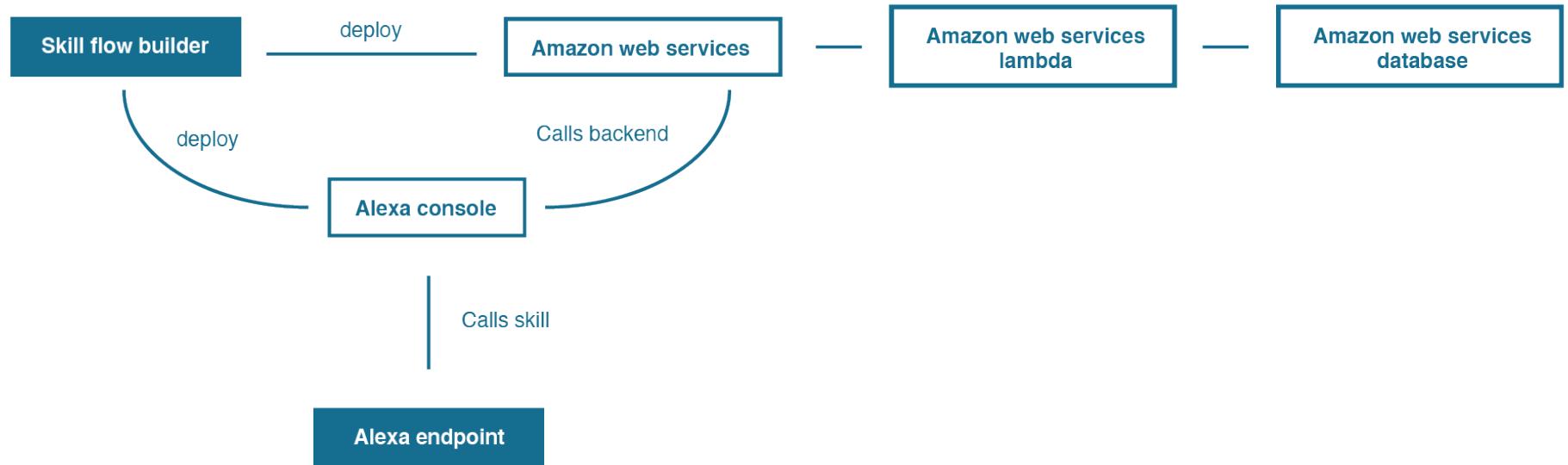
### **Ending questions**

- 6.1. What kind of stories would you like to listen to?
- 6.2. If everything is possible, what would you change or add to the story?
- 6.3. Do you want to say something or do you have any questions for me?
- 6.4. Would you like to participate in a test again in the future?

## Appendix V: table review analysis

	Skill/ Subjects review	Chompers	Toothbrush Time With Fun and Music	Toothbrush Timer	Choose Your Own Adventure
positive	The streak counter	x			
	brushing together/sharing experience	x			x
	appealing to adults	x	x	x	x
	Leaves children hanging/supports the routine	x			
	Variety of content		x		
negative	Lack of attention to brushing/distracting	x			
	Disappointments of a lost streak or content	x	x		x
	Skill name is hard to pronounce	x		x	x
	Annoying constant reminders or commands	x	x	x	
	No variation in content	x			x
	Too many choices/little time to make a choice		x		x
	Children do not automatically like all the content		x		
opportunities	Similar skill for other routine activities	x			

## Appendix VI: Amazon Alexa Skill system components



## Appendix VII: Amazon Alexa Skill system components communication

