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MUVA: a MUltimodal Visceral design Ambient device

Robert Kivac, Sune Øllgaard Klem, Sophus Béneé Olsen, Amalie Bækgaard Solander, Simon Dyrberg von Spreckelsen, Evangelia Triantafyllou and Georgios A. Triantafyllidis

{rkivac14, sklem15, sbol13, asolan15, svonsp15}@student.aau.dk, {evt,gt}@create.aau.dk
Department of Architecture Design and Media Technology
Aalborg University Copenhagen
Copenhagen, Denmark

Abstract. This paper presents MUVA (MUltimodal Visceral design Ambient device), a prototype for a storytelling light- and sound-based ambient device. The aim of this device is to encourage social interaction and expand the emotional closeness in families with children where at least one parent has an irregular work schedule. MUVA differs from the other ambient devices, because it is targeted to children, and it adopts a visceral design approach in order to be appealing to its users. It is a raindrop-shaped lamp, which features audio playing, while its light color is affected by the audio playing. MUVA can be used by parents to store pre-recorded audio of themselves telling stories, which their children can listen to when they are away. In order to investigate if MUVA is appealing to its users and if it creates feelings of closeness between parents and children when the first are absent, we conducted interviews and observations of children and an online survey study with parents. Our preliminary evaluation failed to provide solid evidence on the development of feelings of closeness. However, the majority of children participating in our test found the record function of the product enjoyable, while the majority of parents thought MUVA would be a fun communication method. Finally, our evaluation indicated that both parents and children would prefer another shape and design.

Keywords: Ambient Device; Storytelling; Children; Visceral Design; Ambient Light

1 Introduction

The family structure has changed drastically over the last 60 years. In post-modern families, it is common that both parents join the workforce, which has resulted in a decline in social interaction between the members in a family [10]. According to a study published in 2001, only 1% of mothers were stay-at-home mothers in Denmark [5]. In another study, Deding et al. [12] found that 25% of men and women in Denmark believe that they have trouble in finding a balance between their work and family life. Among the factors affecting this balance, Deding et al. focused on “working non-working hours”.

adfa, p. 1, 2011.

The technological revolution has made work away from the workplace and during non-working hours more common, because it made possible 24-hour contact with the workplace. This availability is known as borderless work [16]. This constant availability has resulted in an increased working load for employees and hence for parents, because it made the boundaries between work and leisure time fluid [8]. Deding et al. [12] found in 42% of Danish families at least one parent has an irregular work schedule, i.e. work during weekends, evenings or nights, while in 14% of them both parents have such a work schedule.

Such changes in post-modern families have an influence on the parenting time devoted to children [13]. When both parents work, time spent by parents with their children often decreases. However, parenting time plays an important role on a child's life, since interaction with the caregivers is paramount for the child's mental and social development [4]. On the short-term parental absence may affect the wellbeing, the social behavior and the mood of children [9]. Leibowitz [19] has also found that first-grade children exhibited significant differences in verbal and mathematical competence that reflected variations in inherent ability but also on the amounts of time and other resources offered by among others parents. In the long-term, parental absence during childhood may have great consequences during children's adult life. Parental absence has been related to development of depression in later life, as well as a negative effect on children's education and academic qualifications [9, 2].

Storytelling is a great tool for bonding between adults and children and it can also be used as a tool to create a relaxed and intimate atmosphere [1]. Wright has also stressed the importance of storytelling in childhood: "*We all need stories for our minds as much as we need food for our bodies*" [26]. Research has also shown that parents' reading contributes to better language development among children [24]. During the last decade storytelling has also received increasing attention because of its potential to promote engagement, enjoyment and fun in interactive digital environments [14].

This paper presents MUVA (MUltimodal Visceral design Ambient device), a prototype for a storytelling light- and sound-based ambient device. The aim of this device is to encourage social interaction and expand the emotional closeness in families with children where at least one parent has an irregular work schedule.

The rest of the paper is organized as follows. Section 2 presents similar approaches in the field of ambient devices and interactive storytelling, and section 3 discusses the design of MUVA. Section 4 describes the technical implementation, while section 5 presents data on the evaluation of our prototype. Section 6 discusses the evaluation results, while section 7 concludes this paper with directions for future work.

2 Background

In the field of interactive storytelling, Zhou et al. [27] developed the "Magic Story Cube", a prototype of an interactive cube for storytelling, which featured augmented reality and tangible interaction. The Magic Story Cube employed multiple modalities including speech, 3D audio and 3D graphics to provide the user (especially children) with multi-sensory experiences in the process of storytelling. Zhou et al. found that this prototype can make storytelling more appealing and understandable to children compared to traditional children's books.

In the last years, there have been developed ambient devices that use light and/or sound and provide different kind of information [25]. An ambient device presents information within a space through subtle changes in light or sound, which can be processed in the background of awareness. Therefore, it uses the physical environment as an interface to provide information without distraction [20]. An example of an ambient device is the Ambient Orb, which is a wireless frosted-glass ball glowing in different colors to display changes in e.g. stock market, traffic, pollen, and weather forecast (www.ambientdevices.com/about/consumer-devices).

Nabaztag is another ambient device shaped as an interactive bunny featuring an adjustable light in the belly, recording/playing of audio messages, as well as Wi-Fi communication with other paired bunnies (http://www.nabaztag.com/). It can also provide information about stocks, traffic, and weather and can create notifications for incoming e-mails, SMS etc.

Angelini et al. [3] presented the anthropomorphic lamp called ADA (Anthropomorphic Display of Affection), which allows displaying and collecting user's emotional states. ADA displays the emotional information changing colors and facial expressions and it allows interaction through tangible gestures typically used in social interactions by humans.

Kowalski et al. [18] developed the Cubble, an ambient device, which uses light for enabling partners in long-distance relationships to share their emotions, simple messages and remote presence. Kowalski et al. found that people, who used the Cubble, reported that it encourages a more frequent message exchange, resulting in a stronger emotional closeness.

The Cubble indicates that an ambient device can be used to enhance communication and maintain emotional closeness between people being apart. In this paper, we present MUVA, a prototype for an ambient device. MUVA differs from the aforementioned devices, because it is targeted to children, and it adopts a visceral design approach in order to be appealing to and entertaining for its users [22]. Our goal was to produce a storytelling ambient device, which would create the emotional state of closeness between absent parents and their children by featuring specific appearance and functionality. Since bedtime storytelling is a well-established tradition in many Danish families [6], we decided to elaborate on storytelling and provide an alternative communication method between absent parents and their children. The following section presents the design of this novel ambient device based on the principles of the visceral design theory.

3 Design of the prototype

MUVA is a prototype for an interactive, light- and sound-based ambient device, which is created as a storytelling night lamp for children. The light of this night lamp can be adjusted to a bedtime story that has been pre-recorded by an adult.

In order to come up with a satisfying design for the night lamp, we took several aspects into consideration such as its shape, light, color, sound and personalization. MUVA is meant to please two individuals – the child and the parent. Hence we tried to produce a lamp that is visually pleasing for the child having it in her bedroom, while incorporating functions that make it easy to use and appealing to parents. We utilized therefore the principles of visceral design.

Visceral design is an emotional design theory wherein the physical features (e.g. size, shape, color and appearance) are dominant, since these factors create an immediate emotional impact on the user [22]. By following a visceral design approach, the aim is to produce an artifact that is attractive and creates enjoyment. In order to create an appealing product for children, we first researched what kind of shapes and appearances appeal to children by exploring popular characters from children's movies. Through this research, we found that in order to construct a likeable and appealing character or product for children, it should include rounded edges and curved figures. This is based on the assumption that rounded edges and curves are associated with something positive, good and likable.

Based on these findings, we created different sketches to come up with the exterior design for MUVA (Fig. 1). However, we decided to go with a simple design instead of a character, because we wanted the ambient light in the night lamp to be the main visual focus. Finally, we chose for MUVA to have the shape of a water drop (Fig. 2). Furthermore, we chose to make MUVA small enough in order to be portable. We decided on portability in order to be possible for children to get attached to the lamp, since they will be able to move around with it or bring it along when outside of home.

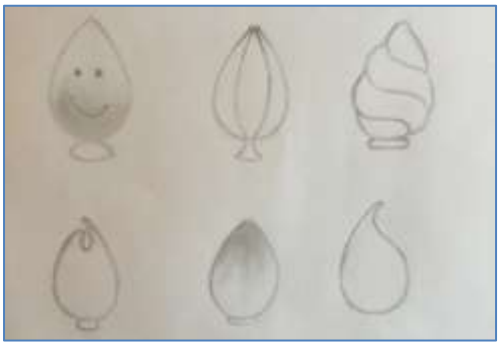

Fig. 1. Different design sketches for MUVA

As far as the color of MUVA is concerned, we chose to provide children with the opportunity to select their preferred color. As Cherry [9] mentions: *"…feelings about colour are often deeply personal and rooted in your own experience or culture.*", so we decided that it was important for MUVA to be adjustable in order to cater for different preferences. The light of MUVA reacts also to the audio being played while in the storytelling mode. The light brightness changes according to the frequency of the sound signal being played.

MUVA’s main function is the ability to playback a recorded sound. Parents can use MUVA to store pre-recorded audio files of them reading a story, which their children can listen to when they are away. We chose also to implement a password function for MUVA, in order for it to be accessible only by authorized users. We believe that this feature may also increase the feeling of attachment among MUVA’s users.

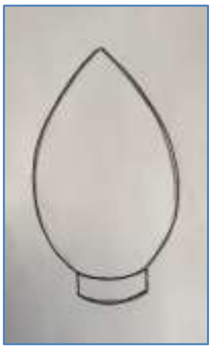

Fig. 2. The chosen shape of a water drop

The following section presents the technical implementation of a MUVA prototype and its featured functions.

4 Technical Implementation

In this section we discuss the implementation of the actual physical lamp and the software that implements MUVA’s functions.

In order to build a prototype of the lamp, we initially built a model in Autodesk Maya. We exported the Maya model as an STL file to Autodesk 123D Make, where we created a skeleton for the lamp. We then constructed the skeleton in 3mm. wood with a laser cutter. We made the lampshade by sewing patches of white cotton cloth together to fit the skeleton. MUVA gets its light by Philips Hue light bulb [17]. We also constructed a pedestal in wood, which acts as a compartment for storing the electronic elements of the lamp. Furthermore, the pedestal acts as a foothold for the socket for the Philips Hue light bulb and hides the wireless speaker.

MUVA contains four different functions, the main function being light reacting to a sound input and three supporting functions, namely a color changing function, a timer function and a password function. These functions were all created in the open source programming language Processing [23], with the use of its Minim and Voce libraries and the Philips Hue software.

While in playback mode, changes in the frequency of the sound being played result in changes in the brightness of a Philips Hue light bulb. Therefore, we implemented a function for converting the audio signal from the time domain to the frequency domain by using a Fast Fourier Transformation. Once in the frequency domain, the brightness is mapped to the amplitude of a specific frequency range, resulting to low amplitudes representing low brightness fluctuation, and high amplitudes representing high brightness fluctuation. As far as the light color is concerned, we developed a color changing function in order for the child to be able to choose the color of MUVA's light bulb. For the two aforementioned functions, we used the Philips Hue Bridge API's, which are the primary tools for controlling the Philips Hue light bulbs. The API is a RESTful interface over HTTP. This means that controlling the light bulbs can be achieved wirelessly.

The audio recording function makes it possible for parents/adults to record a story through a computer before going away, or while being away. This feature gives the parents the opportunity to interact with their children through storytelling even when the parents are not physically present. MUVA features also a timer function that makes it possible for parents to set MUVA to start at a desired time. When the timer goes off, the lamp will start to glow and change color, as well as play a melody. This function will give an indirect notification that the child has to get ready to go to bed.

We developed also a password function in order to give MUVA a more special and personal attachment for the child. By using the speech synthesis and recognition library Voce, the user (e.g. children) is able to choose a password, which MUVA will be able to recognize and accept when spoken into the lamp. Moreover, the pre-recorded story will only be played when the password is accepted.

All these functions were implemented and installed to the aforementioned physical prototype. The final prototype is shown in Fig. 3.

Fig. 3. The implemented MUVA prototype

5 Evaluation

For the evaluation of the MUVA prototype, we employed a convergent parallel mixed research method [11]. The purpose of this explorative evaluation was to investigate user experience and user feelings on the exterior design of MUVA and to explore parents' intention to use such an ambient device. In order to gather data, we conducted two different tests: group interviews and ethnographic observations of children when exposed for the first time to MUVA [7], and an online questionnaire for parents [15].

For recruiting participants for the tests, two non-probability sampling methods were used, namely quota sampling for the children and snowball sampling for the parents. The sample consisted of 6 to 8 year old Danish children, and Danish parents with children in the age of 6 to 12 years.

The first test was conducted at a primary school in the region of Copenhagen, Denmark. During this test, three group interviews were conducted. We interviewed groups of two to three children during each interview. Children of each group reported to be friends with each other. Group A consisted of three boys, Group B consisted of three girls and Group C consisted of two boys. The test took place in an artificial environment, and around a semi-structured interview. Each session lasted approximately 30 minutes and consisted of three parts:

1. An interview, with questions on preferences and habits regarding bedtime storytelling, night lamps, and first impression on MUVA.
2. A demonstration of MUVA and observations of children's reaction to it.
3. Collection of children's opinions regarding the functionality as well as the design of MUVA, by using our own version of the Smiley-based Affective Instrument (SBAI) as a projective technique [21].

The SBAI method was employed instead of a Likert scale, because not all children at the age of our participants master numbers and reading. Normally, the SBAI method consists of nine options but for simplicity reasons we chose to use only five options (Fig. 4). The different smileys from the SBAI method were given the following interpretations (Smiley numbers from Fig. 4):

- Smiley 1: A very negative response to the question.
- Smiley 2: A negative response to the question.
- Smiley 3: An indifferent response to the question.
- Smiley 4: A positive response to the question.
- Smiley 5: A very positive response to the question

Smiley	Fun	Design	Color	Size	Total
1.	2	0	4	5	**11**
2.	0	0	0	0	**0**
3.	3	2	1	1	**7**
4.	1	2	0	0	**3**
5.	2	4	3	2	**11**
Total:	**8**	**8**	**8**	**8**	**32**

Fig. 4. Children's responses collected by the Smiley-based Affective Instrument

During the initial part of the interview, we found that not all children are used to listen to bedtime stories. Furthermore, only four of them reported that they parents often were absent in the evenings. Finally, seven out of eight children had a night lamp in their room.

Through ethnographic observations during the first test, it was found that eight out of eight children showed interest when they were introduced to MUVA, while five of them found the record function amusing. Children expressed preferences on the light color of MUVA and they liked the idea that they could customize the color of the light bulb. Furthermore, five of them proposed that the lamp should be shaped as a character. None of the children could guess that MUVA had the shape of a water drop.

The data collected through the SBAI method was clustered in four overall categories regarding the MUVA characteristics: fun, design, color, and size (Fig. 4). Summing up the responses to all characteristics, we conclude that 44% of the opinions towards MUVA were positive, while 34% were negative. Subsequently, focusing on aspects regarding MUVA's physical appearance (design, color, and size), we observe again more positive responses than negative (45.8 and 37.5% respectively).

The second test involved an online survey, which consisted of two parts:

1. Demographic data collection.
2. Information on MUVA and collection of opinions on the use of MUVA.

We gathered 27 responses from parents of children aged 6 to 12. 81.5% of them reported reading bedtime stories to their children, while the vast majority of them (89%) contact their children by phone when they are away. 59.3% of the respondents reported that MUVA would be a fun way of communicating with their children (Fig. 5), but only 25.9% reported that MUVA could facilitate the communication with their children when they are away (Fig. 6). Finally, 33.7% could see themselves using MUVA in general.

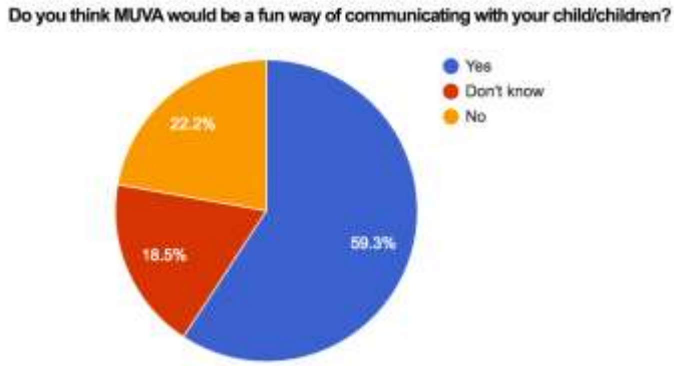

Fig. 5. Parents' responses to the question "Do you think MUVA would be a fun way of communicating with your child/children?" (N = 27)

6 Discussion

A mutual decline in social interaction between members of the family is happening in the modern society. This means that parents do not always have enough time to spend with their children. However, it is of great importance for parents to interact with their children throughout different stages of their lives, to ensure a healthy social and mental development. Research conducted by Kowalski et al. [18] indicated that ambient devices could assist in establishing an emotional closeness between people being away. Therefore, there is some evidence that an ambient device could serve as an approach towards improving the mutual interaction between parents and their children. However, our preliminary evaluation failed to provide solid evidence on this direction. Nevertheless, answers provided by parents indicated that MUVA has some fun elements that could attract children's and parents' attention. By following a visceral design approach, we sought to create a prototype, in which physical appearance would create feelings of attachment and closeness to children. Our data from interviews and observations of children and from an online survey study with parents indicated that both parents and children would prefer another shape and design. However, it was noted that the majority of children participating in our test found the record function of the product enjoyable and that the majority of parents thought MUVA would be a fun communication method. Lastly, one third of the parents could see themselves using MUVA. This implicates that further development could be continued with focus on a redesign of MUVA's appearance.

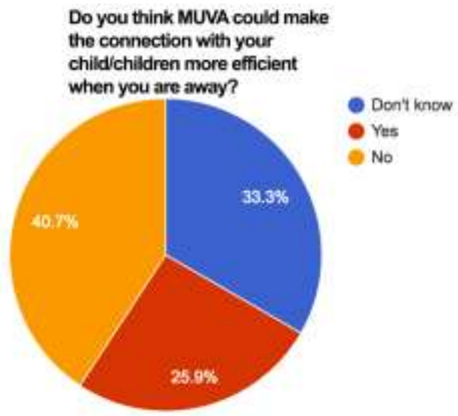

Fig. 6. Parents' responses to the question "Do you think MUVA could make the connection with your child/children more efficient when you are away?" (N = 27)

7 Conclusion

The purpose of this study was to investigate if a light- and sound-based ambient device could improve communication and create feelings of closeness between children and their absent parents. With this aim, a prototype of an interactive ambient night lamp called MUVA was developed that provided parents with the opportunity to read bedtime stories to their children even when they are away from home. With MUVA, parents can record and store themselves reading bedtime stories for their children. MUVA is able to display light changing according to the frequency of the audio played, and change color depending on user's preference. In the future, we would like to develop a new version of a MUVA prototype, taking into account the evaluation results presented in this paper. Moreover, we would like to test MUVA in a natural environment over a longer period of time, in order to be able to gather valid data on the development of feelings, since this process requires time to evolve.

References

1. Aiex, N.: Storytelling By children (1988) Retrieved October 20, 2015, from http://www.vtaide.com/png/ERIC/Storytelling.htm
2. Amato, P. R., & Booth, A.: Consequences of Parental Divorce for Adult Well-Being. Social Forces, **69** (1991) 895-914
3. Angelini, L., Caon, M., Lalanne, D., Abou khaled, O., & Mugellini, E.: Towards an anthropomorphic lamp for affective interaction. Proceedings of the Ninth International Conference on Tangible, Embedded, and Embodied Interaction, Stanford, California, USA (2015) 661-666
4. Astingston, J., & Edward, M.: The Development of Theory of Mind in Early Childhood (2010) 1-7
5. Balvig, F., Nygaard Christoffersen, M., Mørch, Y., & Mazanti Sørensen, K.: Ungdomssociologi. Copenhagen: Forlaget Columbus (2001)
6. Bak, L., Epinion, & Leadership, P.: Danskernes kulturvaner 2012. Kulturministeriet (2012)
7. Bjørner, T.: Qualitative Methods for Consumer Research. ISBN: 978-87-412-5853-9. København: Hans Reitzel (2015)
8. Bjørnstrup, V., Matthiesen, T., & Skov, O.: Identitet og senmodernitet – Med stress som case (2013) ISBN: 978-87-616-6190-6
9. Cherry, K.: Color Psychology (2015) Retrieved December 16, 2015, from http://psychology.about.com/od/sensationandperception/a/colorpsych.htm
10. Christoffersen, M.N., Mørck, Y., & Sørensen, K.M.: Ungdomssociologi (2001) ISBN: 87-7970-023-3. Copenhagen: Forlaget Columbus
11. Creswell, J.W.: Research Design: Qualitative, quantitative and mixed methods approaches. 4th ed. Thousand Oaks, London, New Delhi, Singapore: Sage Publications (2014)
12. Deding, M., Lausten, M., & Andersen, A.: Børnefamiliernes Balance Mellem Familie- og Arbejdsliv (2006) 1-140. ISBN: 87-7487-837-9
13. Dencik, L.: Growing up in the post-modern age: On the child's situation in the modern family, and on the position of the family in the modern welfare state. Acta Sociologica, **32**(**2**), (1989) 155-180. doi:10.1177/000169938903200203
14. Garzotto, F., Paolini, P., & Sabiescu, A.: Interactive storytelling for children. Proceedings of the 9th International Conference on Interaction Design and Children (2010) 356-359.
15. Gillham, B.: Developing a questionnaire (2nd ed.) (2000) Continuum International Publishing Group.
16. Gonas, L:. Balancing family and work to create a new social order. Economic and Industrial Democracy, **23**(**1**) (2002) 59-66
17. Koninklijke Philips Electronics N.V., (2012). Philips Hue. United States of America.

18. Kowalski, R., Loehmann, S., & Hausen, D: Cubble: A Multi - Device Hybrid Approach Supporting Communication in Long - Distance Relationships (2013) 201-204
19. Leibowitz, A.: Home investments in children. Marriage, family, human capital, and fertility. Journal of Political Economy, **82** (**2**) (1974) 111-135
20. Markopoulos, P., Ruyter, B., & Mackay, W.: Awareness Systems Advances in Theory, Methodology and Design, **1** (2009) 27-29
21. Moore, A., Steiner, C., & Conlan, O.: Design and Development of an Empirical Smiley-based Affective Instrument (2013) 1-12
22. Norman, D.: Emotional design: Why we love (or hate) everyday things (1st ed.) (2004) 20-70. New York: Basic Books.
23. Reas, C., Fry, B.: Processing (Version 3.0.1) (2001) Boston, Los Angeles, New York,: Fathom Information Design, UCLA Arts Software Studio, NYU's ITP.
24. Sénéchal, M., LeFevre, J. A., Hudson, E., & Lawson, E. P.: Knowledge of storybooks as a predictor of young children's vocabulary. Journal of Educational Psychology, **88**(**3**) (1996) 520
25. Wisneski, C., Ishii, H., Dahley, A., Gorbet, M., Brave, S., Ullmer, B., & Yarin, P.: Ambient Displays: Turning Architectural Space into an Interface between People and Digital Information. Lecture Notes in Computer Science Cooperative Buildings: Integrating Information, Organization, and Architecture, (1998) 22-32
26. Wright, A.: Storytelling with children (1995) Oxford University Press.
27. Zhou, Z., Cheok, A., Pan, J., & Li, Y.: Magic Story Cube. Proceedings of the 2004 ACM SIGCHI International Conference on Advances in Computer Entertainment Technology - ACE '04, (2004) 364-365