Easybottle: *A study of metaphor in interaction design*

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Abstract

Lately, various kinds of intelligent products have been invented, and to play a part in the "intelligent" era, I designed an intelligent nursing bottle which can help a user when making up a bottle for a baby in middle of the night. The intelligent nursing bottle, Easybottle is a behaviour induce interaction product, which means that it motivates a user to do something with pleasure. As a mother of one year old, I learned that it is very important for a caregiver to feel satisfied in order to nurse a baby from the heart. Easybottle provides sound modality to notify the caregiver how much water she should pour when mixing powdered formula with water so she does not need to feel agitated to read bottle markings in middle of the night when her eyes are not fully awake.

The methodology that I applied is metaphor. As metaphors, I chose two different sounds to compare; sound of water pouring and sound of a car's proximity sensor. The main goal was to define more useful interface for Easybottle.

I conducted quantitative within-participants experiment. This study explored whether lifelike sound works better or artificial sound works better as an indication interface. Participants evaluated the water pouring sound interface more positively than a car's proximity sensor sound interface. Lifelike and hedonic factor appeared to be attractive to the participants and it implies that even though Easybottle is an electronic product, participants appreciate more when it reminds them of nature. Also, entertainment factor is important when doing a chore.

Keywords: *Design strategy, interaction, interface, user experience*

Introduction

Background of the Study

Lately, various kinds of intelligent products have been invented, and to play a part in the "intelligent" era, I designed an intelligent nursing bottle which can help a user when making up a bottle for a baby in middle of the night. The intelligent nursing bottle, Easybottle is a behaviour induce interaction product, which means that it motivates a user to do something with pleasure. As a mother of one year old, I learned that it is very important for a caregiver to feel satisfied in order to nurse a baby from the heart. Easybottle provides sound modality to notify the caregiver how much water she should pour when mixing powdered formula with water so she does not need to feel agitated to read bottle markings in middle of the night when her eyes are not fully awake.

Objective of the Study

The objective of the study is to determine more effective sound interface for Easybottle. Two sounds were compared in the study; water pouring sound and a car's proximity sensor sound. Water pouring sound is used as an example of a lifelike sound, and a car's proximity sensor sound is for an artificial sound.

Related works

Intelligent Products

An intelligent product is a robotic product in which information and robotic technologies are integrated into an existing common product[1]. Intelligent products can understand, decide, and act according to the environment[2].

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[1] Kwak, S. S. (2015). The Effect of Degree of Relevance of the Product Functions on People's Acceptance of an Intelligent Product – Focused on an Intelligent Door -. Journal of Digital Design, 15(2), 9-17. doi:10.17280/jdd.2015.15.2.002

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[3] Kim, W. (2001). A Study on Functional Feature Groups for Intelligent Product Design System (Unpublished master's thesis). Yonsei University

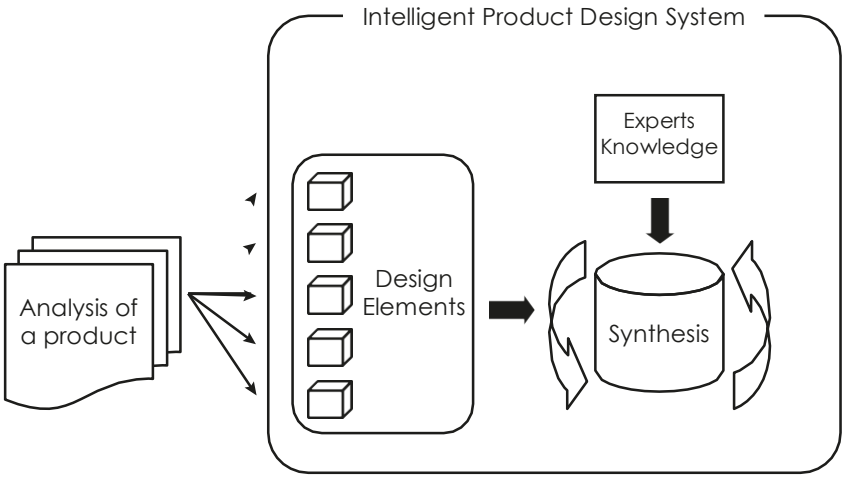

Figure 1: Required process in building an intelligent product design system[3].

In order to design an intelligent product, the product which needs to be redesigned need to be analyzed thoroughly to extract elements that could be fixed or improved. When parts to be reformed are defined, the designer can choose how it should be enhanced using sensors, such as a light sensor, a pressure sensor, a humidity sensor, etc.

In this study, a nursing bottle was chosen to be improved and light sensors were used as enhancements. I focused on milk pouring action into the nursing bottle. Especially at night, I always had hard time reading the gradient marking on the nursing bottle, so I had to bend my body forward and lower to read the marking on the nursing bottle which is on my kitchen counter while my hand is above my head, still pouring the milk into the bottle. It got me thinking how easy it would be if I could pour milk to the point without looking at the markings. This thought lead me to design a bottle that notifies the bottle marking with sound.

Metaphor

"Metaphor" allows designers to design products through more effective process[4]. The word, metaphor was originally used in Linguistics. A metaphor is the expression of an understanding of one concept in terms of another concept, where there is some similarity or correlation between the two[5].
Conventional metaphor is used for communication or academic purposes. In contrary, conceptual metaphor is used very often to understand theories and models. It uses one idea and links it to another to better understand something[6]. Because of this attribute, conceptual metaphor is useful for designers to develop a new system or concept, and metaphors that are discussed in this paper are conceptual metaphors.
Domain Distance Theory of Metaphor claims that it is attractive to an audience when between-domain distance is far and within-domain distance is close. Jung interpreted that farther the between-domain distance is, the more the audience gets interested. However, when within-domain distance is close, the metaphor makes sense to the audience. Close within-domain distance means that attributes of source element and target element are somehow similar.
Two sounds that I decided to experiment with are water pouring sound and a car's proximity sensor sound. A car's proximity sensor is somehow similar to pouring milk up to a point because it notifies when to stop. And the between-domain distance is far because one is driving a car and the other is pouring milk into the bottle.
Between-domain distance of water pouring sound is not very far because the only difference is types of liquid that is being poured into the bottle. Within-domain distance is definitely close as they both are liquid that are pouring into bottles.
According to the Domain Distance Theory, a car's proximity sensor sound interface, Bibeap should be more attractive to users, however lifelike sound has always been appealing to users. It was very interesting to observe which factor is more temping to the users.

Hypothesis

The sound interface of an intelligent product is more effective when it is a lifelike sound than an artificial sound.

Study Design

The experiment is designed to compare lifelike sound interface and artificial sound interface. Water pouring sound was used as lifelike sound interface (Pokpo), and beeping sound was used as artificial sound interface (Bibeep).

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[4] Jung, Y. (2011). Interactive Product Design based on Domain Distance Theory of Metaphor (Unpublished master's thesis). KAIST

[5] Metaphor. (2016, June 02). Retrieved November 21, 2016, from http://www.glossary.sil.org/term/ metaphor

[6] Conceptual metaphor. (2017, August 11). Retrieved August 18, 2017, from https://en.wikipedia.org/wiki/Conceptual_metaphor

Participants

Thirty-six people aged from 15 to 85 (twelve males twenty-four females) who live in Seoul Korea participated in the study.

Materials

To begin the experiment, I built the interface using LittleBits[7] which is very useful in the beginning stage of the design process. Two light sensors and two mp3 players are used in the first prototype. The LittleBits circuit is shown as figure 1, and two sets were used in the prototype.

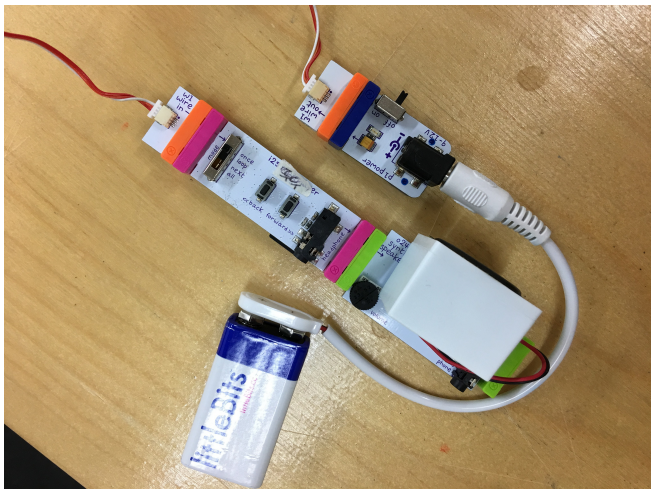

Figure 2: LittleBits parts that are used in the first prototype; light sensor and mp3 player.

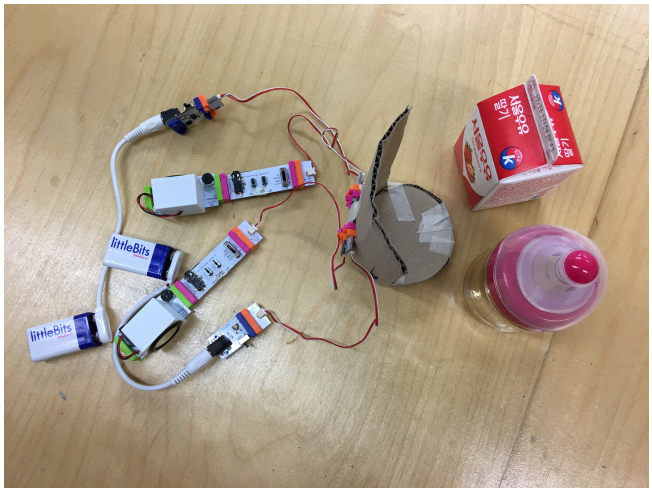

Figure 3: The first prototype

[7] LittleBits makes a platform of easy-to-use electronic building blocks empowering everyone to create inventions, large and small. The description is from https://littlebits.cc

Two light sensors are allocated vertically so when the lower light sensor is triggered, the mp3 player plays repeated short interval beeping sounds, and when the higher light sensor is triggered, the mp3 player plays a continued beeping sound.
The first prototype was used for a pilot survey and based on this survey, I built a developed version with Arduino IDE. In this version, I added one more light sensor to be triggered when milk pouring starts. When milk pouring starts, either water pouring sound or beeping sound will start.
I designed the sound interface in three-steps. As for Pokpo interface, water pouring sound begins when the participants start pouring the milk, smaller volume of water pouring sound will play as milk reaches the middle point, and when it reaches 160ml point, water dropping sound will play to imply to stop pouring the milk. For beeping sound interface, longer interval beeping sound begins to play when the participants start pouring the milk, shorter interval beeping sound will play as it reaches the middle point, and continued beeping sound will play when it reaches 160ml point to signal to stop pouring the milk.
For the first prototype, I used cellphone flashlight to provide light as the light source for , but for the later version, I embedded red LED lights for the light source.

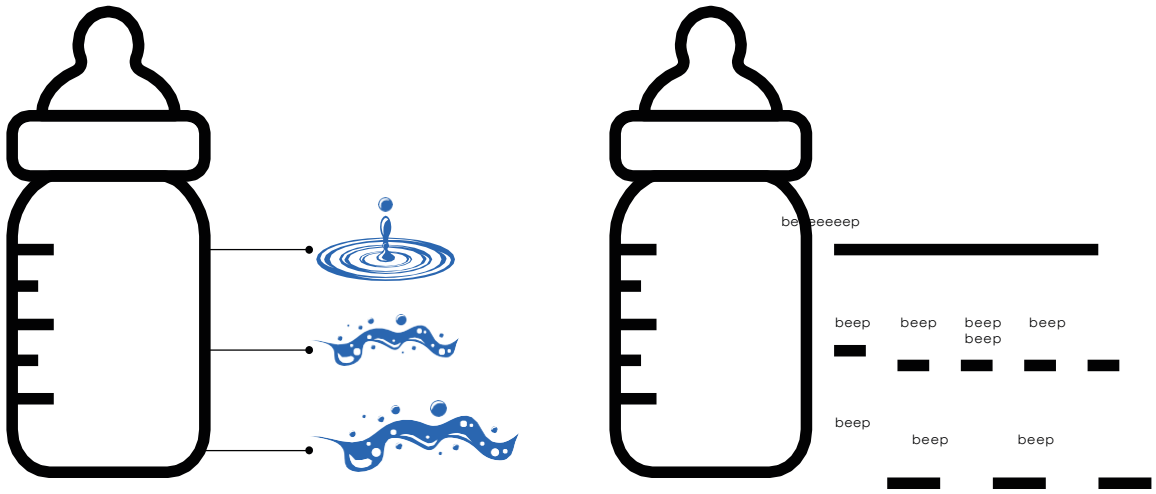

Figure 4: Water pouring sound interface, Pokpo, and a car's proximity sensor sound interface, Bibeep.

Procedure

Participants were welcomed to the lab and were instructed to pour milk into nursing bottle twice, once with Pokpo interface and another with Bibeep interface, in random order. After participants poured milk into nursing bottle with each sound interface, they filled out questionnaires.

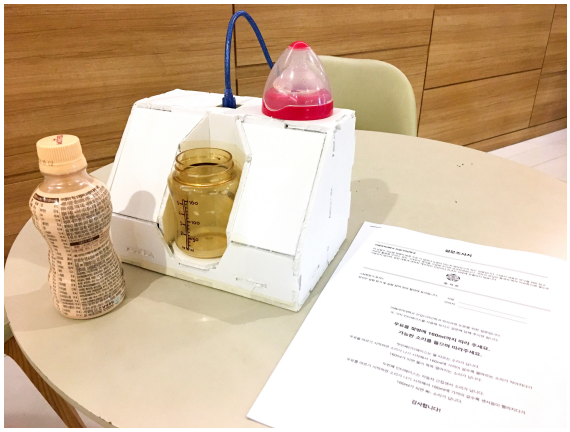

Figure 5: Easybottle interface ready for participants to experiment.

Measures

In the first part of the questionnaire, I asked usefulness[8] of the interface, and product evaluation[9][10]. Usefulness of interface is for dependent measure, and is an index of two items, "I think this nursing bottle is useful to me" and "It would be convenient for me to have this nursing bottle". The index is very reliable ($\alpha = .957$). Product evaluation is an index of four items. The four items are "very bad / very good," "very poor / very excellent," "very negative / very positive," and "very unfavorable / very favorable." The index is very reliable ($\alpha = .969$).
In the second part of the questionnaire is composed of questions asking about purchase intension[11], orientation[12] between utilitarian and hedonic, animacy, machinelikeness[13] and behaviour induce product. Purchase intension is an index of two items, and they are "How much do you wish to purchase this nursing bottle?" and "How much do you really wish to purchase this nursing bottle?" The index is very reliable ($\alpha = .979$). The orientation is an index of four items. The items are utilitarian/hedonic, useful/fun functional/pleasant, and assists to accomplish one's purpose/gratify one's senses. The index is very reliable ($\alpha = .944$).
For manipulation check measures, degree of animacy[14] iss measured by using the six items; dead/alive, stagnant/lively, mechanical/organic, artificial/lifelike, inert/interactive, and apathetic/responsive. The index of animacy was very reliable ($\alpha = .913$).

Results

The statistic shows that the participants felt Pokpo is more useful than Bibeap (M_{water}=5.78, SD=1.32 vs. M_{beep}=5.43, SD=1.42; t=1.745, df=35, p< .05). The participants wanted to purchase Pokpo more than Bibeap (M_{water}=4.97, SD=1.72 vs. M_{beep}=4.64, SD=1.87; t=1.307, df=35, p< .1). Even though the result is marginally significant, I decided to include in this paper. The participants thought Bibeap has more

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utilitarian aspect than hedonic aspect, and Pokpo has more hedonic aspect utilitarian aspect (M_{water}=4.17, SD=1.93 vs. M_{beep}=3.26, SD=1.86; t=4.040, df=35, p< .0001). Also, they felt Pokpo was more lifelike than Bibeap (M_{water}=5.32, SD=1.06 vs. M_{beep}=4.32, SD=1.73; t=3.674, df=35, p< .0005). Obviously, Bibeap was more machinelike than Pokpo (M_{water}=4.03, SD=1.54 vs. M_{beep}=5.50, SD=1.42; t=4.751, df=35, p< .0001). Participants felt Pokpo induces their behaviour more than Bibeap (M_{water}=5.08, SD=1.52 vs. M_{beep}=4.70, SD=1.75; t=1.290, df=35, p< .1). The hypothesis was supported by the data.

Interpretations of the Results

Participants evaluated the water pouring sound interface more positively than a car's proximity sensor sound interface. Lifelike and hedonic factor appeared to be attractive to the participants and it implies that even though Easybottle is an electronic product, participants appreciate more when it reminds them of nature. Also, entertainment factor matters when doing a chore.

Limitations

There are some limitations to this study. First, milk was used in the experiment instead of powdered formula and water as it would be in a real situation. I would like to conduct an experiment with powdered formula and water to mimic the real situation in the future. Second, all the participants were from Seoul Korea. Future studies could include participants from different backgrounds and cultures. Third, the experiment was evaluated also by people who has never nursed babies. In the future studies, I would like to recruit people who is currently nursing babies younger than a year to examine the usefulness of the Easybottle. Lastly, the experiment did not include a section to examine the Domain Distance Theory of Metaphor due to complication. I would like to focus on proving the relation between water pouring sound and beeping sound, and domain distance of metaphor in my future studies.

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