

# Fluenci: the expression of expressing

## Abstract

In this paper, we discuss the design process of a breast pump which celebrates expressing as a natural, intimate and emotional experience. Through interviews with mothers and breastfeeding experts, the psychological and physiological factors which may inhibit or stimulate the milk let-down reflex were identified. Based on this information, a concept called Fluenci was developed which, in its interaction and behavior, mimics many of the stimulating triggers provided by a baby. In an evaluation of an experience prototype of this concept, users preferred Fluenci over a conventional breast pump both on a pragmatic and a hedonic level. We discuss our design rationale in which the product's functionality benefits from anthropomorphic interaction and behavior yet does not result in a potentially disturbing anthropomorphic product appearance. Lastly we propose an additional form of anthropomorphism, Embodied Anthropomorphic Form, which invites the user to engage with a product as if it were human. Keywords. Expressing, anthropomorphism, product behavior, prototyping, interaction design, product design.

## 1 Introduction

Especially in Western culture, an increasing number of mothers start to combine employment and parenting within months after birth. The World Health Organization promotes mother milk as having benefits for both baby and mother [1]. However, breastfeeding

during working hours is often not possible. Also, the mother and baby might not be physically able to breast feed. An alternative is expressing mother milk at work using a breast pump and feeding the baby the expressed milk. There is much room for improvement in the design of breast pumps, especially regarding the unpleasant experience mothers have while expressing. This paper describes the design process for a breast pump, in which we focused on the aesthetics of interaction and took the intimate experiential dimensions of normal breastfeeding as point of departure.

## 2 Inhibitors and Stimulants in Expressing

Seven mothers were interviewed on their experiences with expressing. The interviewees were asked to act out their expressing ritual and show the location and breast pump used. In addition, two lactation consultants provided expert knowledge on expressing. The interviews showed that the let-down reflex, which causes the ejection of milk, is influenced by a number of interdependent physiological and psychological factors.

### 2.1 Inhibitors

Oxytocine, the hormone that triggers the let-down reflex, and adrenaline, the hormone associated with fear and pain, are antagonists [2]. Discomfort and anxiety therefore inhibit lactation. Sources of discomfort can include work-related stress and suboptimal expressing tools. Most mothers indicated that they 'feel like a

<sup>1</sup> The Eight-Bit Mirror was developed by Felicity Powell, Nick Redwood and Dylan Turney; Deimous by Anneke Crouse, Brandon Dawson and Sahil Vallabh; [sol] by Tarei King, Zak Henry and Thorsten Ziller.

<sup>2</sup> This quote and the following quotes are taken from design documents written by the students.

cow' during expressing and described the experience as a very 'mechanical', even degrading ritual (figure 1). Sources of anxiety include a lack of privacy: many work places lack a breastfeeding room and mothers fear that colleagues will see them partially unclothed and expressing. Secondly, fear of not being able to express can lead to a vicious circle.



**Fig. 1. Illustration of mother using a breast pump at work.**

## 2.2 Stimulants

Whilst the primary stimulant for the let-down reflex is the suckling on the nipple and areola, the mother seeing, hearing and smelling the baby and feeling its warmth and trampling also contribute to the reflex. To mimic these stimuli during expressing, mothers use warm compresses, massage their breasts and rely on simulated 'triggers' from their baby. For example, mothers may look at photos or videos of their baby, listen to recordings of its sounds or bring pieces of clothing that carry its smell. These stimuli help to mentally visualize the baby and provide a conditioned trigger for the let-down reflex [3], [4].

## 3 Benchmarking Existing Expressing Methods

There are several ways to express milk. The simplest way is through massaging the breast with the hands. This method requires quite some practice and can be physically heavy. Therefore mechanical devices were developed: manual breast pumps. Breast pumps are designed to imitate the physical suckling of the baby on the nipple. Such manual breast pumps (figure 2a) are usually powered by squeezing a handle. Though manual pumps are quiet and relatively cheap, their use can be

tiring. Electric breast pumps (figures 2b & 2c) provide suction using a (separate) motor. The efficacy of electric pumps is higher than that of the manually operated ones, but the electric pumps are more expensive, larger, noisier and require a connection to a power socket or regular charging.

Current pumps address expressing on physical level but do not provide additional emotional or physiological triggers. On the contrary, the interviews revealed that the users related both product appearance and sound to cow milking equipment. The interaction is strongly machine-like in feel, with controls that are difficult to operate or even out of reach when holding the pump.



**Fig. 2a. Hand pump.**



**Fig. 2b. Electric pump.**



**Fig. 2c. Double electric pump.**

## 4 Concept Design

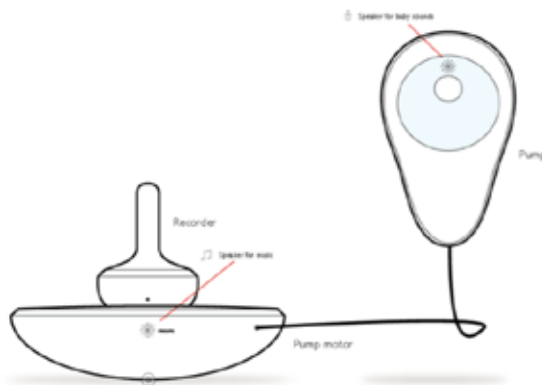
Based on interviews with mothers and experts, a breast pump concept called Fluenci was developed and built (figure 3). The interaction with Fluenci was designed to be evocative of breastfeeding a baby and to avoid the machine-like connotations of traditional breast pumps. Fluenci features automated, baby-like behavior which eliminates the need for physical controls, contributing to a calm, object-like appearance.



**Fig. 3. The handheld part of the breast pump.**  
**Note the thermofoil wires in the breastshield and the circular tapping area.**

#### 4.1 Baby-like Interaction

The interaction with Fluenci mimics many of the sensorial triggers provided by a baby. When the user holds Fluenci's soft, organic shape, her posture and gesture resemble the cradling of the back of a baby's head. The product's form contributes to reducing anxiety by hiding the nipple and most of the breast from view, thus providing privacy from incidental glances. Through electric thermofoils, the breast-shield is heated to body temperature, which widens the mammary ducts – thus stimulating the let-down reflex [5]. Similarly the back of the unit is heated to simulate the warmth of a baby's head. A digital sound recorder allows mothers to record and playback their baby's sounds or listen to music that they also listened to during breastfeeding, thus triggering conditioned reflexes. The baby's sounds are played back from the handheld pump, nearby and directed solely to the mother. Since the music supports creating a more ambient atmosphere, it is played from the base unit which houses the pump motor, which is more distant, both physically as well as psychologically.



**Fig. 4. System overview: recorder, pump motor and breast pump.**

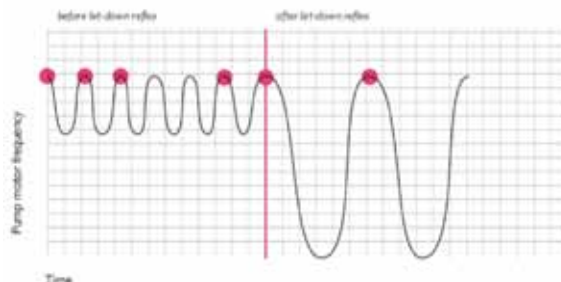
#### 4.2 Baby-Like Behavior

Fluenci starts pumping when the breast shield is placed correctly on the breast and stops when it is moved away. This behavior resembles that of the baby (figure 5). Fluenci's milk flow sensor allows it to mimic a baby's changes in suckling frequency. A baby starts with suckling quickly and superficially to stimulate the let-down reflex. Once the milk starts flowing, the baby's suckling slows down as it drinks the milk. Similarly, Fluenci starts pumping stronger and at a lower frequency once it detects the flow of milk (figure 6). This optimizes the milk production and minimizes the chance of sore nipples. In case the mother wishes to override this automated process, a touch sensor on the product allows the mother to determine the pumping speed through three taps in the desired frequency, without having to reach over to the pump unit.



**Fig. 5a. Pump switches on when placed on breast.**

**Fig. 5b. Pump switches off when removed from breast.**



**Fig. 6. The frequency and amplitude of the pump automatically change after the let down reflex has been detected.**

## 5 Experience Prototyping

Experience prototyping was an essential element during the iterative design process. Initially, low-fi wooden prototypes with an integrated speaker were made, which could play sounds from an mp3 player. These were used to get feedback from the users in the first concepts.



**Fig. 7. User with one of the low-fi prototypes combining basic electronics and Phidgets within a housing of laser cut MDF.**

The final prototype was fully functional, including an Arduino prototyping board, speakers, sensors, heating elements and a 'hacked' Avent breast pump, all programmed in Cycling74's MaxMSP software. The final model was 3D printed. For hygiene reasons, the prototype could not be used to express milk.



**Fig. 8. Making the final prototype, using McNeel's Rhino 3D modelling software, 3D printing, an Arduino microcontroller board and Cycling74's MaxMSP programming environment.**

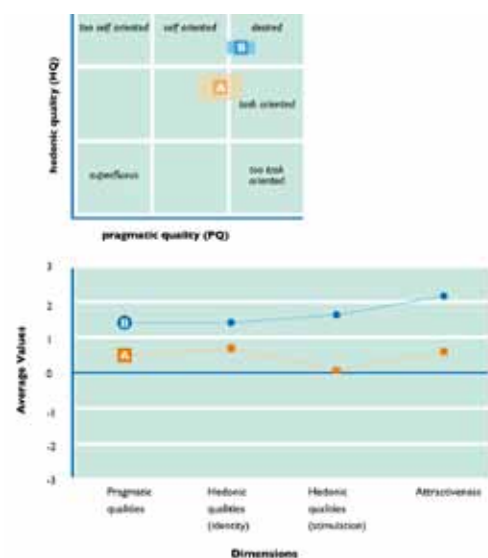
## 6 Concept Evaluation

Six mothers were asked to compare the final Fluenci experience prototype against a traditional, high-end electric breast pump (figure 10). Both pumps were preassembled and accompanied by custom-made quick-starting guides. The participants were asked to



**Fig. 9. Part of the final prototype.**

act out the expressing ritual – evoking a 'let-down reflex', adjusting the pump frequency, and so on, after which they ranked the pumps using AttrakDiff semantic differential scales [6]. The results (figure 11) indicate that Fluenci is rated higher than a traditional electric pump, both in terms of pragmatic and hedonic quality. On a side note, the Fluenci concept is rated as more isolating (as opposed to connected), which influences the hedonic identity dimension negatively, though actually 'isolation' can be a positive attribute since it might indicate that Fluenci provides privacy.



**Fig. 11. AttrakDiff results, A is the Avent pump, B is the Fluenci pump.**



**Fig. 10. Concept evaluation with end users and prototype.**

Semi-structured interviews confirmed the positive outcome of the AttrakDiff test. The way of holding Fluenci, the warmth and the optional playback of sounds were much appreciated. Aspects which received criticism were the dimensions of the milk bottle which should be increased to allow capturing more milk and the control of the pump frequency which should be more precise and direct.

## 7 Discussion of Semantic Considerations

A breast pump is an intimate product of which the functionality is strongly influenced by its look and feel. How the user feels she is perceived by the outside world and the feel of the product's interaction and behavior have a direct psychological and physiological influence on its core functionality: the stimulation of the let-down reflex. Here semantics are not limited to the product's appearance in isolation but include the user-product interaction.

The central semantic question in the design of Fluenci was to which extent the product should be anthropomorphic. Anthropomorphism is defined as the attribution of human-like qualities to inanimate objects or animals [7]. They focus on a part of anthropomorphism, which they call 'Anthropomorphic Form': the imitation of human form by designers as manifested in the objects they create – be it static or dynamic. DiSalvo et al. define four kinds of anthropomorphic forms:

1. Structural (imitating the appearance or functioning of the human body with a focus on its materiality)

2. Gestural (imitating the ways people communicate with and through the human body with a focus on human behavior)
3. Aware (imitating the traits, roles or functions of people as a social role)
4. Anthropomorphic Form of Character (imitating the common human capacity for thought, intentionality, or inquiry).

Due to Fluenci's multi-sensorial nature, it is interesting to see how it can be positioned in their framework.

In general, Fluenci can be seen as an Anthropomorphic Form of Character. The playback of baby sounds, the suckling behavior and responsiveness to the user are expressive of a 'needing-role'. Fluenci's size, human-like warmth and organic 'neck-like' curvature invite it to be cradled. The pump hereby not only defines its own role, but potentially also changes the (self) image of the mother in her social context.

The suckling of Fluenci would be Gestural Anthropomorphic Form – the suckling can be seen as motions that suggest human action. The suckling behavior contains elements of Aware Anthropomorphic Forms as well – Fluenci seems to be aware of being held to the breast and attentively adapts the suckling rhythm to the milk supply from the mother, memorizing the favorite settings. This behaviour suggests intelligence and thereby minimizes the feeling of operating a machine. The warmth Fluenci gives can be seen as an example of Structural Anthropomorphic Form; it imitates the warmth of a human body, resulting from its 'operation'.

The warmth relaxes the milk ducts and provides comfort when holding it against unclothed skin, hereby stimulating the let-down reflex.

It is difficult to position Fluenci in DiSalvo's framework when focusing on its form. Fluenci's form is not Aware Anthropomorphic, since it does not express consciousness or awareness. It is not an Anthropomorphic Form of Character, because it does not per se display qualities or habits that define a role like a baby. Fluenci's form is not recognizable as an imitation of the appearance of a baby's head (structural anthropomorphism). A breast pump with the looks of a real baby would project a bizarre, possibly even disturbing image, the so-called uncanny valley effect [8]. Similarly, a breast pump with a video screen showing the baby's face would turn the product into a robotic piece of machinery. Gestural Anthropomorphic Form is using motions or poses that suggest human action to express meaning, but the emphasis is on actions performed by the anthropomorphic object – not on the actions from the user of the object.

Therefore we suggest a fifth kind: Embodied Anthropomorphic Form. Though the product itself does not visually resemble (parts of) a human body, its design invites the user to interact with it as if it were human. Hereby the meaning arises from the (inter)action with the product, both in physical and in social terms. In the case of Fluenci, its shape affords to be held by the mother in a particular, cradling manner. Once the mother holds Fluenci in this way, the similarity to feeding a baby can be experienced.

## 8 Conclusion

We set out to design a breast pump that would make expressing a more enjoyable experience for the mother, by restoring the mother's intimate multi-sensorial engagement during expressing and triggering her instinctive milk reflex. Our evaluation of Fluenci shows that we made considerable improvements compared to existing breast pumps. Instrumental for the final result was the iterative, hands-on design process and focus on the interaction experience, making use of anthropomorphic form that goes beyond simple product appearance, entering the realm of embodied interaction.

## Acknowledgments

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**J. Knoester,**  
**J.P. Djajadiningrat,**  
**P.R. Ross**  
Philips, Technical  
University of  
Eindhoven



# Fictional emotions within emotion driven design

## **Abstract**

The aim of this paper is to address imaginative experiences of emotions by drawing Kendall Walton's theory of make-believe. Moreover, we use a design case as means for investigating how a child's felt emotions towards a hospital situation relates to his or her imaginative experiences of emotions towards a fictive character in a computer game simulating the real-world situation. In so doing, we contribute with new insights to existing theories of emotions in design, which tend to focus narrowly on felt and measurable emotions.

## **Keywords**

Fictional Emotion, Emotion Driven Design, Interaction design

## **1 Introduction**

Theories of emotion's role in design have been successful in explaining many new levels of product meaning and product experience that until a few years ago were hardly understood [1], [2], [3]. However, a number of knowledge gaps inherent in these theories become evident when working with new modes of interaction and time-based experiences in game design. While theories of emotions offer exhaustive frameworks for describing how emotion driven design is able to elicit emotions, the questions as to how such emotions may change and evolve over time has only received little attention.

Secondly, theories of emotions in design have a tendency to focus too narrowly on the user's felt and sensed emotions, while the question of how imaginative experiences of emotion relates to an emotional state is left largely unaddressed.

The aim of this paper is to address imaginative experiences of emotions by drawing upon Kendall Walton's theory of make-believe [4]. More specifically, we will use a design case to investigate how a child's felt emotion (towards a hospital situation) relates to a child's imaginative experiences of emotion towards a fictive character in a computer game.

In this paper we will first introduce the notion of 'fictional emotions' as a new key concept in design research that accounts for how a persons felt emotions relate to a persons response to a fictional world.

Secondly we will introduce our design case, which is using the design of an experimental computer game (called the Child Patient Game) designed especially for hospitalized children as research artefact. The purpose of the Child Patient game is to design a computer game environment that can map the subjective feelings felt by children being in hospital. Here we will look especially into the relation between Character Experience (that of the fictive character in the game) and Player experience (that of a Patient).

Thirdly we will explain the method of inquiry; the overall method of this project, which is built up from a research through design method [5], [6] as well as