

# A user-centered approach to affective interaction

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**Abstract.** We have built eMoto, a mobile service for sending and receiving affective messages, with the explicit aim of addressing the inner experience of emotions. eMoto is a designed artifact that carries emotional experiences only achieved through interaction. Following on the theories of embodiment, we argue emotional experiences can not be design in only design for. eMoto is the result of a user-centered design approach, realized through a set of initial brainstorming methods, a *persona*, a *Laban-analysis* of body language and a *two-tiered evaluation method*. eMoto is not a system that could have been designed from theory only, but require an iterative engagement with end-users, however, in combination with theoretical work. More specifically, we will show how we have managed to design an *ambiguous* and open system that allows for users' *emotional engagement*.

## 1 Introduction

Our approach to affective interaction differs somewhat from the goals in affective computing [13]. Instead of inferring information about users' affective state, building computational models of affect and responding accordingly, our approach is *user-centered*. Our aim is to build systems that have users engaged in interaction. We want users to feel they are involved in an intriguing communication with the system and through the system with each other. Therefore, users should be allowed to express their own emotions rather than having their emotions interpreted by the system. To ensure this engagement, we apply iterative design methods involving users continuously in the design cycle. What we build are designed artifacts that embody this user experience, but it is only in interaction with users that we can tell whether we have succeeded [6]. Thus, our approach is user-centered in both aims and methodology.

Research in psychology and neurology shows that both body and mind are involved when experiencing emotions [3,4]. It is common knowledge that emotions influence people's body movements and sometimes emotions become reinforced or even initiated by such bodily signals [5]. Thus, it should be possible to design for stronger affective involvement with artifacts through addressing physical, bodily interaction modalities. Tangible interaction [11], gesture-based interaction [1], and

interaction through plush toys and other artifacts [12], are all examples of such physical modalities. We have summarized our design aims into what we name an *affective loop*. In an affective loop, users may consciously express an emotion to a system that they may or may not feel at that point in time, but since they convey the emotion through their physical, bodily, behavior, they will get more and more involved with the experience as such and with their own emotional processes. If the system, in turn, responds through appropriate feedback conveyed in sensual modalities, the user might become even more involved with the expressions. Thus, step by step in the interaction cycle, the user is ‘pulling’ herself as well as is being ‘pulled’ into an affective loop.

To design for this intriguing affective loop experience we have taken inspiration from Gaver and colleagues and their work on ambiguity [8]. Most designers would probably see ambiguity as a dilemma for design. However, Gaver and colleagues [8; p. 1] look upon it as:

*“[...] a resource for design that can be used to encourage close personal engagement with systems.”*

They argue that in an ambiguous situation people are forced to get involved and decide upon their own interpretation of what is happening. As affective interaction oftentimes is an invented, on-going process inside ourselves or between partners and close friends, taking on different shades and expressions in each relationship we have with others, ambiguity of the designed expressions will allow for interpretation that is personal to our needs. Ambiguous design is also related to embodiment that regard meaning as arising from social practice and use of systems [6]. An open-ended ambiguous design allow for interpretation and for taking expressions into use based on individual and collective interpretations. Ambiguity in a system will also allow for ambiguity and meaning making. However, there has to be the right level of ambiguity, since too much ambiguity might make it hard to understand the interaction and might make users frustrated [9].

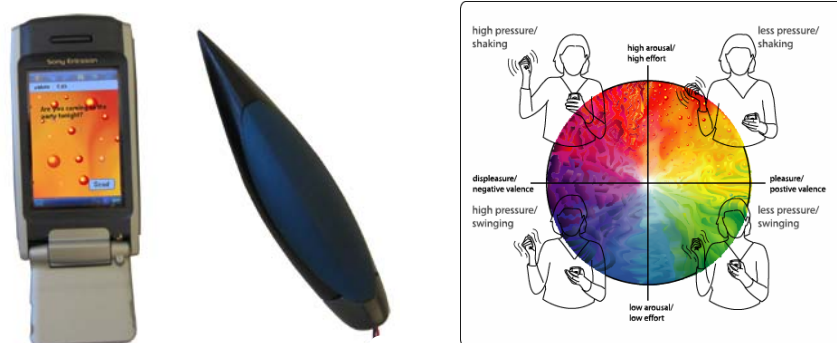
As a research vehicle we have designed, implemented and evaluated a mobile service named *eMoto* (see Figure 1), a system that embodies our design ideas. In here, we will use *eMoto* to exemplify on our user-centered design approach. We will discuss how we have used a combination of theory and iterative engagement with end-users to design an ambiguous and open system that allows for users’ emotional engagement. Before we turn our methodology we will however first present our design in some detail.

## **2 eMoto**

*eMoto* is built in Personal Java and runs on P800 and P900 mobile phones, two of Sony Ericsson’s Symbian phones. Both phones have touch-sensitive screens that the user interacts with through a stylus. In *eMoto*, the user first writes a text message and then finds a suitable affective graphical expression to add to the background of her text. To find this expression, the user navigates in a circular background of colors, shapes and animations through using a set of affective gestures, see Figure 1. The gestures are done separately from writing the message and require consciously pressing and shaking the stylus in order to move around in the background circle. The

stylus pen has for this purpose been equipped with an accelerometer and a pressure sensor. The original stylus that comes with Sony Ericsson's Symbian phones has the size and shape of a toothpick, which is convenient for the purpose of interacting with the touch screen, however, it does not have the shape that users can be physical with in the way that is intended by our design aims. Thus we looked for a more physical design, but a physical design that in itself is nothing more than an artifact. The shape should not limit the user but instead allow her to express herself in a range of different movements and gestures. We wanted the stylus to fit better in the hand and to be formed in a material that physically would respond back to the user. The final design would also have to fit all the technology that was needed for the extended stylus to act as a wireless sensor network, still; we wanted it to keep its purpose of being suitable for interacting with the touch screen. We did not want to attach the sensors to the mobile phone since that would require users to first interact with the gestures and then look for feedback on the mobile phone, an interaction model that do not fulfill the definition of the affective loop where timing of expressions and feedback are essential.

**Fig. 1.** The left figure shows the extended stylus and eMoto running on a P900 while the right figure shows the interaction design; high pressure makes the user go left on the background circle to more negative emotions while intense shaking takes her to the top to more energetic emotions (the animations can be seen on [emoto.sics.se/animations](http://emoto.sics.se/animations))



## 2.1 The Affective Expressions

We aim to avoid a labeled or iconic view of emotions; instead we want to design for more of the inner experience of emotional expressions. Both gestures and graphical expressions are designed from an analysis of emotional body language where we have used Laban-notation to extract underlying dimensions of emotional gestures [7]. Neither the gestures nor the graphical expressions can nor should be mapped to a specific emotion in a one-to-one relation. The mapping between the gestures and the graphical expressions is, however, a key factor to emotional engagement in an affective loop. It is essential that both gestures and the graphical feedback build on the same inner experience of emotions for users to get more and more involved in the interaction. The aim is ambiguous expressions that blend into each other and open for interpretation. Since it is the inner experience of emotions that is desired, and also,

since it is not the gestures that are communicated to the receiver of these messages, the exact three-dimensional shape of the gestures is not important and therefore not captured. Instead the gestures are set up as combinations of pressure and movement. This allows for physical engagement but opens for users' personal body movements. Figure 1 describes the four extreme gestures having those two variables. However, in between those extremes there can be a whole range of combinations of movement and pressure. Ambiguity is also applied on the design of the graphical expressions in the background of messages. The expressions, formed as a circle, are non-symbolic and designed from what is known about the effects of colors, shapes and animations. These graphical expressions are also what is communicated to the receiver and then also aim to convey more of the emotional content through the very narrow channel that a text message otherwise provides.

### 3 A User-Centered Design Process

Designing an artifact that aims to embody emotional experiences in interaction is extremely hard to create simply theory. Instead, this must be done in interaction with users. Theory and abstract reasoning is not enough when the aim is to say something of how a designed artifact will be used and understood in practice [6].

Regarding the eMoto service, more specifically, we have aimed for ambiguity as one of the means to design for user involvement and emotional experiences. Important is to find the right level of ambiguity for a specific user group and the only way to do this is to involve users in the design process. There are several ways to do this but we have used a *questionnaire*, the *persona method* and a *two-tiered evaluation method*.

The questions of our questionnaire, sent in the beginning of this project to 80 potential users, concerned how well users felt that they could express emotions through SMS. The results revealed a need for richer expressions and also a frustration with current means. For example, some indicated that they made use of smilies, but said the few smilies they actually used had quite many limitations to what they could express. Most of the women said they more often used words to express the emotional expression they wanted to convey but they also said it often was hard to verbalize a complex emotional state.

The questionnaire results were used to create a *persona* [2]. A *persona* is a precise description of a hypothetical person, which in the design process, is an alternative way to talk about the targeted user group as one user and steer the design process. The *persona* set up for the eMoto service is named Sandra. In short she is a confident 29 year old woman who likes to spend time with her friends and family. Sandra does not care much of how things work technically, but she likes new cool features and she is very happy with her new mobile phone that has a camera and internet functionalities. Sandra is a smart woman, who also is very open and keen on having the ability to express herself, a woman who stands a high level of ambiguity.

In the design and implementation phase we have used a *two-tiered evaluation method* [10], which implies that each part of an affective interaction system must be evaluated on its own and redesigned before combined into an overall design and

evaluated against its purpose. It might be that an idea of an affective interaction system is really good but unless the expressions used in each part of that system are understood by the end-user, the overall idea will fail anyway. Therefore it is important with continuous interactions with users during the whole design cycle, and not just when the final design already has been set.

Thus far, two user studies have been conducted on eMoto. First a user study to validate the level of ambiguity in the colors, shapes and animations before they were combined and, in a second study, evaluated together with the affective gestures. For both user studies we have recruited users similar to our persona.

The first graphical expressions study was performed by subjects in pairs in front of a laptop in a lab environment. 6 pairs took part in this user study which was set up as a modification of the classical think aloud technique. Users were set in situations where they had to discuss various parts of the affective background circle.

After some redesign of the graphical expressions a second user study of eMoto was conducted to see if our idea of creating an open and ambiguous interaction model by only capturing the underlying dimensions of emotional gestures and not their exact shape was enough to make users emotionally involved in the sense defined by our affective loop idea. 18 subjects participated in this user study which also was set in a lab environment but this time as individual sessions and with the system running on a P900 mobile phone connected to the extended stylus. The results related to the gestures as such have been published elsewhere [14]. In here we will discuss results that relate to users' emotional engagement achieved by an ambiguous design and use this to argue for our user-centered design approach.

## 4 Results Related to our User-Centered Design Approach

To make users involved with their own emotions and with what they want to express to the recipient of their message it is important they are not forced to simplify neither the expressivity of the gestures, nor the expressivity the message they send. To achieve this involvement, the affective loop, we have therefore strived for a somewhat ambiguous design of both gestures and graphical expressions. However, the right level of ambiguity is not found through solely one user study. Instead, we have worked iteratively with user studies and redesign to find this level for our specific system and user group. Let us present some of the results from our user studies illustrating how one can strive for and find the right level of ambiguous expressivity through involving users in the design process. We also discuss how this ambiguity in turn allowed for emotional engagement, but also how this is related to users' personality: this kind of system will not fit for everyone, but mainly for the intended user group – our *persona*.

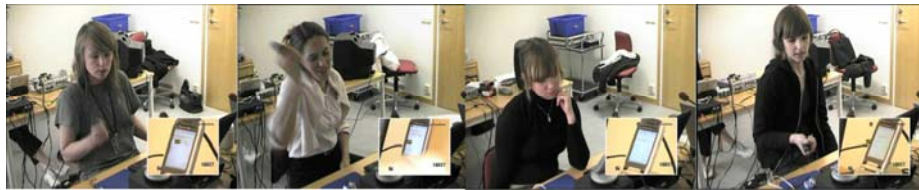
**Ambiguity.** Regarding ambiguity of the expressions our design goal was to find a level where the expressions are open for interpretation and personality but still has some generality between subjects so that they can understand each other. In the first user study users interpreted one of the objects in the graphical background circle in a too depictive way. 3 groups out of 6 associated a specific object with a rose and thereby with romance rather than the frustrated expression it was supposed to portray.

According to our idea of users engaged in an affective loop, the mapping between the gestures and the graphical background need to be set up in a way where the expressions build on the same inner experience. This would not be the case if we were to have an object resembling a rose in the area a user navigates to with frustrated and angry gestures.

Regarding the second user study and the openness of the gestures, the prototype did not have any sensors for registering the exact shape of gestures, for example, whether users held the stylus above their head, in their lap or down low, but this we found to be a consistent pattern related to different emotions. 14 subjects held the stylus high up in the air for excited emotions and 9 subjects held the stylus lower, often in their lap, for sadness (which can be seen in Figure 2). One subject commented on this:

*“Up high for emotions that goes up and low down for emotions that go down. Angry is more straight.”<sup>1</sup>*

**Fig. 2.** Subjects involved in the four scenarios (see Table 1); ‘the racist doorman’, ‘the perfect job’, ‘the ex-boyfriend’, and ‘the hammock’



**Table 1.** Scenarios

<b>Scenarios</b>	
The racist doorman	You write to tell a friend that you and your other friend could not get into the bar because of a racist doorman.
The perfect job	You write to tell your boyfriend that you got the job you applied for even though there were over a thousand other applicants.
The ex-boyfriend	You write to tell a friend that your boyfriend who you love so much has dumped you.
The hammock	You write to a friend who is at work telling her that you are relaxing in the hammock.

Our intention is to capture the inner experience of the affective gestures and from that the communicational aspect of the gestures, the shape of them, is not important. The shape of gestures is, however, one aspect of users’ personal expressivity and emotional involvement. Our aim has been not to design for anything like a new sign language but instead allow users to add their own personal shapes to the gestures. The results show that users added shape to their gestures and to them it also seemed as if the system was capturing that. Regarding the graphical expressions, however, the communicational aspect is important both for the user to get involved in the affective loop but also for her to be able to express herself. The results show that since users

<sup>1</sup> All citations are translated from Swedish by the authors

could add their own shape to the gestures they could also more easily resemble characteristics of the graphical expressions which to the users made the mapping more coherent than what we had anticipated in the theoretical parts of our design process.

**Emotional Engagement.** The results also show that capturing the underlying dimensions of movement and pressure was enough for users to get emotionally engaged in the interaction. Moreover, it was obvious that users got more relaxed and enjoyed themselves more when they got to do the gestures in a context, in combination with the graphical feedback and having scenarios, summarized in Table 1, to which it made sense to react emotionally. Users were asked to interact with the extended stylus to find suitable affective expressions to these scenarios. The first picture in Figure 2 shows a subject engaged with ‘the racist doorman’ scenario. She not only had a stern facial expression and bit her teeth together really hard, but she also uttered:

*“Now I’m really pissed and it’s night time and we were gonna have fun together and...”*

The second picture shows a subject engaged with ‘the perfect job’ scenario. This subject waved her hand in the air and smiled. In the third picture a subject engaged in ‘the ex boyfriend’ scenario expressed depression both in her face and in how she just hang her arm down with a very loose grip on the stylus. Finally, in the last picture the subject was neutral and she just held the stylus in her hand for ‘the hammock’ scenario. A video analysis, based on the authors’ interpretation of the subjects’ usage, their facial expression and their general appearance, showed that 12 subjects out of the 18 got emotionally engaged with ‘the racist doorman’, 15 with ‘the perfect job’, 14 with ‘the ex-boyfriend’ and 16 with ‘the hammock’ scenario. For these subjects it was the overall interaction that had them emotionally engaged and not the designed artifact nor the graphical expressions in themselves a notion that could not have been validated without interactions with users.

**Personality.** The second user study of eMoto, however, indicated that users’ personality had an effect on their emotional expressions and experiences of the interaction. In a concluding questionnaire the first question was about using gestures to express emotions. When comparing the answers to this question with the results from the video analysis it became even more apparent that there were two groups of users. 12 subjects of the 18 felt relaxed when using their body language:

*“Cool! It really feels like I’m communicating the emotions I’ve got without being aware of them.”*

*“I think that’s really good, especially if you have had a hard time to express yourself in words. It can also be a fun complement to other ways of expressing yourself.”*

While six subjects were a bit uncomfortable in doing so:

*“Hard! Partly because you have so different strength and partly because it’s basically hard.”*

*“I think it would be easier to gesticulate in front of a camera and do small movements. That would feel better in an environment with a lot of people.”*

The video analysis of the subjects’ emotional engagement when interacting with the scenarios also showed that these six subjects had a more difficult time than the rest of the subjects to relax and be engaged with the prototype and the scenarios. This can partly be explained as a mismatch between their personality and the targeted user group for eMoto, Sandra. In general, some users might be more open to physical, bodily expressions than others. However, further studies are needed to disentangle whether this is the reason behind this difference.

## 5 Conclusions

We have presented a user-centered approach to affective interaction, user-centered in both aims and methodology. In here, we have used eMoto, a mobile service for sending and receiving affective messages, as a touchstone to illustrate how a user-centered perspective can help to achieve design aims from an embodied interaction perspective [6]. More specifically, we have discussed how we have used ambiguity in affective expressions to design for openness and emotional engagement. We argue that a user-centered perspective could be used to a greater extent within affective computing to generate ideas that are intuitive to users but which also give them stronger emotional experiences.

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