Conscious Cloud: Experimenting with Imagined Physics to Induce Hedonic Aspects and Behavioral Change

(Mads Møller Eriksen)
Shape-Changing Interfaces
Aarhus University
(mme87@cs.au.dk)
(20084180)

ABSTRACT
This paper explores how transitions, light, interaction, shape-change and materials can create a metaphor that cause feelings and change in behaviour within people. Through experiments and the making of prototypes, we have explored each of these design parameters and how they have an impact on the hedonic goals. If just one of these aspects works against the whole design, the experience can suddenly change drastically to something far from the designers' initial intention. Reflections will therefore be made correspondingly to the design parameters exploited and how they can exist in interplay and support each other within imagined physics. Finally, we propose future explorations within the field of imagined physics.

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Shape-changing interfaces; form, volume; hedonic; imagined physics

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H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Human Factors; Design;

INTRODUCTION
Shape-changing interfaces has been an involving field of research within HCI over the last decade. A major amount of work has already been done within this area to clarify how such interfaces can be used and manipulated. [6] Has developed a design space that categorizes eight types of shape-change and how the use of these can influence hedonic aspects such as emotions and aesthetics. Recently, additional research has been done by [5] to show how shape-changing interfaces incorporate imagined physics as a tool to create new and maybe magical experiences. Little to none examples exist that explore imagined physics and how the use of metaphors can impact the perceived interaction by the user.

In this paper I will explore how imagined physics can be used in developing a shape-changing lamp. Through experiments and prototypes I will investigate how different design parameters such as light, material and movements impacts emotions and cause behavioural change.

I will start by introducing related work to the main topic shape-changing interface and introduce earlier projects that were a part of the research done by [5, 6]. Secondly, I will briefly describe my research problem followed by the methods used in the design process. Furthermore, this section includes how we conducted experiments with light, imagined physics and materials to reach a final prototype that contained hedonic and persuasive design. Additionally, this section will contain the results from the insights gained. Subsequently, I will address the implications of the explored design parameters and in what way our design relates to the TEI-conference [7]. Finally I propose future research within the field of imagined physics.

RELATED WORKS
Nørgaard et al. present the term 'imagined physics' as a way to describe how associations with metaphors can be used to persuade users into certain kinds of interactions. The paper builds upon eight sketches from which they elaborate their findings and results. Individually, each of these sketches is based upon one of the eight forms of shape-changes presented in the vocabulary generated by [6] through their study of earlier shape-changing interfaces. The types of changes are orientation, form, volume, texture, viscosity, spatiality, adding/subtracting and permeability. Furthermore, they studied different forms of interaction with the shape-changing interface as well as how materials can transform an object into another shape. Through the study of these sketches and how these explore the three categories, types of change, interaction and transformation, [5] present a three-dimensional design space of imagined physics. The objects studied can be placed accordingly to the axes physical/virtual, volatile/consistent and visible/hidden. The three axes relates to how the physical form behaves in sense of how far it goes beyond our comprehension of the real world. By using metaphors designers can choose to make a direct connection between input and output. On the other hand, denying the use of the very same, could lead users to make their own understanding of the object studied. [5] Also discusses the use of actuators in shape-changing and argues that solely the mechanic sound can impact the object in such a way that it can amplify the designers intention or

simply work against it. Stressing sounds could for example persuade users to stay away from the object. On the opposite, a smooth a calming sound could cause a user to hug or in other ways interact with the object. In interplay with shape-change these feelings has the possibility to be enhanced through for example quick or slow movement and persuade the user to act in different ways.

One project related to create or amplify human emotions is [8] whose research shows how shape-changing interfaces can be used to persuade a user into predetermined behaviour. Through the use of servomotors, wire and a plastic tube, they have created Thrifty Faucet that uses life-like movements to simulate facial expressions to persuade the users' actions in a way so they think about how much water they use when going to the bathroom. Among the feelings that emerged though the user study of Thrifty Faucet were fright and amusement. This leads to Togler et. al's conclusion of how shape-changing interfaces can create awareness about water consumption and in the end cause a change in behaviour.

Another way to use metaphors from the nature or other physics to communicate hedonic aspects is the shape-changing computer mouse presented in[3]. They believe that by using different metaphors for transitions, like a heartbeat, it is possible to amplify the excitement, tension and thrill while playing a game. Nonetheless, as stated by [5], and also shown through the various examples, materials play an important role in shape-changing interfaces. [1] Has created a list with different materials, including smartmaterials such as Shape Memory Alloy(SMA) that can be used to transform input stimuli into controlled material responses through heating. An example of SMA in use is [4] where it is adding/subtracting the object accordingly to the input. Additionally, they also use light as an output, which is coherent to our object of study.

RESEARCH PROBLEM

Although the previous examples from related work shows how well shape-change can be used to enhance emotions and create awareness, it seems that a lot of the research done within the field of shape-change only studies one or two design parameters at a time. Furthermore, it is clear that sound from actuators, type of interaction, type of shape change, materials, metaphors, temporality and functionality all play an important role in how an object is perceived in terms of anthropomorphism/zoomorphism and how people act when presented with hedonic aspects and persuasive technology.

There has been little or no work done to explore this connection between multiple factors, and especially in how the sound created from actuators influence the overall experience. [5] Mentions this in her paper, but not how it impacted each of the sketches studied.

This leads to my research problem. I will explore the design parameters: type of shape-changing, material, imagined physics, light and transformation in relation to the hedonic and persuasive aspects of shape-changing interfaces and how they support each other in creating a behavioural change for the user.

METHOD

This project was done as a part of a seven-week masters course in shape-changing interfaces at Aarhus University. We were required to work within a given scope and create our prototype from the research done by [5] and transfer it to a shape-changing lamp. Further, it was a requirement that the final concept complied with the submission guidelines provided by the TEI-conference [7].

Experiments

In the beginning of the design process we experimented with different types of shape-change and how it could be used in making a lamp. Five rapid prototypes were made that all explored how light behaves when being exposed to different types of shape-change.

Each of these experiments had their own qualities in terms of how their type of shape-change, light and material worked together to create one whole experience. One experiment explored how a red light emitting diode combined with glue sticks could simulate glows from a fire when moving in front of and around the red LED.

Although, we chose to continue the work on our "weather system", see figure 1, because it involved aesthetic, expressive and metaphorical qualities when the wool added and subtracted in front of the light bulb. These movements created a soft and playful light when the "sun" was up and a stressing and disturbing light when we quickly turned the sun on an of as if it was lightning.

Figure 1: "Weather system". Wool simulating clouds and a light bulb imitates the sun.

Prototype

To take the results from the experiments a step further we explored how it was technological possible to make an interface that behaved like a weather system with moving clouds, changing colour and changing spatiality.

We ended up using mechanical actuators to move the wool in different directions in front of the cloud, See figure 2, but shortly after the testing, it became clear that the

mechanical sound and robotic movements made by the actuators ruined the organic and calming aspects of the weather system.

To handle the shortcomings of our prototype and to produce an aesthetically, emotional and persuasive shape-changing interface we investigated what kind of a material that could function as an actuator without creating noises. Through our investigation, we ended up with SMA-wire, which in contrast to the mechanical actuator were soundless but still able to create the transitions we were looking for to create organic movements.

Additionally, the direct transformation of a weather system into a metaphor seemed to leave the user with different ideas of how the interaction should occur. Instead we wanted to present the users with only two visual states to make it easier for them to understand what was communicated.

Figure 2: Rapid prototype using actuators to change spatiality, and a light bulb and polyester to create a metaphor for a weather system.

Through our earlier experiments and based upon our own experience, a cloud could be used to clearly communicate emotions from frustration shown as thunder in cartoon movies to calmness through the aesthetically pleasing sunrise. We decided to build the final prototype upon these hedonic aspects and from here on, experiment with how the material, type of shape-change, transitions and interaction could amplify feelings and lead to behavioural change.

RESULTS

Through our research and experiments we ended up with a final prototype, see figure 3 or [9], that explored how different design parameters affected the user behaviour. The results found is presented as a recap of how the choices and experiences influenced our final design.

Transitions and materials

To enhance users mental state and awareness as in [3] we decided to shift between two states. One, which I will call the 'static state' and another I will call the 'state of thunder'. When shifting from a static state with calm light and smooth transitions to the state of thunder, we used the SMA-wire to produce a more dynamic movement. Thereby enhancing the feeling of disturbance and thus amplifying the metaphor of lightning to create awareness of the cloud. See [9]. Furthermore, to induce calmness when in static state the SMA-wire only produced soft and organic movements. From the insight gained through the earlier experiences we chose to use polyester around the physical architecture of the lamp. This fabric had qualities such as the depth in texture it created when light and shape-change occurred. Furthermore this caused a stronger metaphor within the two states so the user clearly could interpret and hereby interact the way we intended.

Figure 3: Final prototype in the 'steady state'.

Interaction/mapping

To create a mapping that corresponded to the installation, we chose to take the number of unanswered text messages as an input. When the number of unanswered messages reached four or more, the cloud would turn to its state of thunder to induce stress and irritation. The association with thunder and the awareness of a disturbance would in the end lead to a reaction from the user causing him to read his messages. When done, the lamp changes back to its steady state and the user can relax knowing that there are now no unsolved tasks to take care off.

We believe that the prototype created is best suited for a home installation. By placing it in an already stressing environment, like in a workplace, it would be more difficult to induce a relaxed and calm feeling. Furthermore, since people tend to bring their work to their home, were there is suppose to be a calm and relaxing environment, we would create two different situations through our object. One where we would like the user to be aware that he can relax and another were we would like the user to handle his unanswered work messages. This way of interaction can booth be seen as direct or indirect. If looking at the definition of implicit indirect interaction created by [6], such interaction happens when someone sends a message unaware that it creates an output in our object. The user that reads the messages, don't use this form of interaction because he realizes that answering text messages makes the thunder go away- at least this is the intended interaction, otherwise, indirect or no interaction at all would not cause any awareness or change in behaviour. There is no term in [6] that covers this way of interaction since direct interaction is when you through deforming the shape, while the changes in shape are simultaneously used as output. Therefore we will call this explicit indirect interaction because you realise what impact you have on the output.

Hedonic and behavioural aspects

When testing the final prototype we discovered how the cloud metaphor created situational awareness and urged a change in normal behaviour for the users. This result was a

product of how we used the materials, light, transitions and type of shape change to create imagined physics. The output from the design parameters then evolved into associations between certain emotions that were connected with the metaphors of lightning and the calming light shining through the clouds. Next, this amplified the feeling of either relaxation or an irritation making you want to handle the unanswered messages.

DISCUSSION

Through our research, we have shown how a multitude of design parameters can impact the hedonic and behavioural aspects of shape-changing interfaces. Still, we have only explored just a fraction of the characteristics concerning the creation of aesthetic experiences and how to use situational awareness combined with emotions to persuade the user into behavioural change. Therefore, further exploration within the field of imagined physics and how different design factors can impact emotions still needs to be done.

The work of [6] shows that only one fourth of the projects studied in their research conduct user evaluation to some extent. Thus, we do not know if our conceptual model is perceived as intended by the user. Questions like, what would happen if we choose to use the sound from mechanical actuators instead of no sound? and what if we were to use a less direct metaphor? is hard to answer without testing it in real context. Although we cannot tell for sure, earlier projects such as [2,8], indicates that by using metaphors in shape-change it is possible to, in some extent, to change human behaviour and emotions.

Another question that arises is how well the different design parameters supported each other in the overall goal of the design. Even though we used SMA-wire to get rid of any disturbing mechanical sound we had to use relays to control the form because of the high amount of amps that we had to inject. This caused the relay to create a clicking noise, which then led to a distance between what was associated with organic movement and what the user would perceive. Other design parameters such as the type of shape-change, light, transition, fabric and induced emotions all supported the cloud in its metaphor and would very likely have an impact on the behaviour from the user. The final prototype presented us with other aspects of which could be further studied. Regarding the fabric and light used, adjustments could be made to draw even more on the imagined physics. This was an on-going discussion within the group since we had to consider the pros and cons in every design choice and how they would have an impact on the user experience.

To meet the submission criteria for the TEI-conference, we built a tangible object that uses computational technology. Additionally, it operates through conceptual and experimental properties to generate a creative concept within the area of shape-changing interfaces.

CONCLUSION

Our research has contributed with additional knowledge to the creation of imagined physics through the use of shape-changing interfaces. It showed us how the interdependency of movements, materials used, light, sound created and type of shape-change can contribute to a hedonic and behavioural change. Furthermore, the research conveyed some problems that emerged when putting all the design parameters together when building a strong metaphor and how a small change in the choice of a material can cause relaxation instead of frustration and anger.

For future work, we propose an investigation of how light can work as a design parameter at the same level as material and interaction. Finally, we want to test our prototype in a real world scenario to get concrete insights from users as also proposed by [6].

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