SUSTAINABLE LIGHTING
– DESIGNED CONSIDERING EMOTIONAL ASPECTS

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Abstract

Global warming challenges designers to pay attention to environmental effects of manufacturing when designing new products. This examination project was a personal challenge to uphold ethical responsibility as a designer and consider emotional aspects of design while aiming to create a pleasurable lighting for the home environment.

The underpinning idea for the project was to promote the use of recycled materials and an environmentally friendly light source aiming to create a sustainable everyday commonplace product that it is possible to manufacture. High power LED-technology was chosen because of its energy efficiency, flexibility and a particularly long life-cycle. Recycled plastic and fibre cardboard were chosen to be applied as the shades of the lamps. Both these recycled materials can be broken down and recycled again after use.

Emotional design aspect was the leading theory in the design process. The intention was to consider different levels of emotional aspects when defining the main characteristics of the lamp to create pleasurable lighting: Among usability and aesthetics the concentration was on the semiotics of the product and its usage context. It was designed with the aim of evoking pleasurable feelings in users who desire to lead an active and urban life-style but who are simultaneously worried about global warming.

Both of the lighting designs are for a dining context. They are supposed to create a pleasurable atmosphere around a dining table while separating the party around the table from the rest of the space. Other lights can be dimmed or switched off when it is time to gather around the table to accentuate the illumination and feeling of togetherness.

Inspiration for the project came from sustainability, contemporary thoughts and trends embodied into maps. The products turned out to be silent statements of today’s global world; Antarctica refers to glacial retreat while Town symbolises the importance of people’s own origin in this globalised world.

Keywords: Light, lighting, sustainable design, experimental design, emotional design, ethical responsibility, sustainable product development, semiotics
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INTRODUCTION

Background

Motivation
Global warming is a big issue today. The issue is complex because it simultaneously concerns everybody and nobody. Sustainable development should be considered in everyday activities, but to be an environmentally conscious consumer requires a lot of time and effort which can reduce the amount of actual sustainable consumer activities or habits.

As a designer it is particularly important to consider sustainable development when it comes to industrially manufactured products. In theory there exists the possibility that the designer’s decisions and judgments during the design process cause more positive or negative environmental impacts than can be caused as a single consumer. Instead of concentrating on repairing the damage and pollution caused in the production process, it is more important to focus on preventing environmental damage in the first place. Designers have to carry the responsibility of the consequences of their design decisions instead of disregarding designers’ ethical responsibility.

This examination project was my first attempt at deriving a design process which has sustainability as a basic principle. As Lao Tse has once stated – “The longest journey starts with a single step”. The world cannot be changed in one day, but single activities can lead to a great change in the long run.

Goal
The goal of this Master’s thesis was to design an everyday product while bringing together sustainable development with the concentration on product characteristics which evoke pleasurable feelings in users. The idea was to create a LED lighting design with a shade made of recycled materials. The intention was to design lighting to be the main light source of a space rather than a decorative one, to illuminate a space in a cosy way while harnessing the advantages of LED-technology. Emotional aspects were considered through the process aiming at creating a lamp which is desired for use for a long period. Easy recyclability at the end of the product’s life-cycle was an important aspect to be considered as well.
Sustainability

According to the United Nations’ 2005 World Summit, sustainable development does not focus solely on environmental issues but also on the interdependent and mutually reinforcing pillars of economic development, social development and environmental protection. In this thesis the sustainable aspect is emphasized on environmental issues. Leading design processes with an emotional design aspect can be considered to be supporting another pillar; social development. Economic aspects would naturally be applied to the case if the end product was released onto the market.

The use of recycled materials saves natural resources and reduces the need for energy intensive resource extraction (Sheehan 2000). Operating on zero-waste level or closed loop production would be the ideal material cycle when manufacturing new products.

In this project the idea was to co-operate with companies which are located near to each other and promote the use of recycled materials. Important issues to take into consideration were also the product’s lifetime energy usage and recyclability in the end of its life-cycle. All of these were considered at the starting point of the design process of aiming to offer emotionally pleasing lighting that would suit this setting.

Materials and Sources

Essence of Light

Lighting defines what we are or are not able to see. Nothing can be seen without light. Lighting affects on our behaviour, mood and wellbeing. Shadows and darkness are an important part of lighting beside the light itself. Light is an important interaction instrument between human beings and environment (Nikunen, company introduction). With illumination it is possible to create either a pleasurable, efficient, cosy or threatening atmosphere.

![Figure 1: Light can make a flat surface seem three-dimensional.](image)
High Power LED (light emitting diodes)

LEDs are semi-conductors that convert electricity into light (Lighting Research Center). The reason why high power LEDs were chosen to be the light source in this project was that LEDs are considered to be one of the most environmentally friendly light sources due to their energy efficiency and particularly long life. LEDs can consume up to 80 percent less energy than traditional incandescent light sources.

High power LEDs are even more energy efficient than the traditional LEDs. When compared to a fluorescent source, LEDs have far more potential as a light source in future because of the diverse applications in which they can be used (Modigh, J, Wennerström Ljuskontroll AB, personal communication). Fast developing LED technology opens a great variety of possibilities to illuminate spaces and objects.

Other benefits of LEDs are their ability to produce more light per watt than incandescent bulbs. Frequent on-off cycling does not harm them and they sustain external shocks well. (Mustonen,H, Tepcomp Oy, personal communication) The problem of fast developing LED-technology is the lack of standards when comparing the quality of LEDs from different manufacturers. (Annell, S, Annell Ljus + Form AB, personal communication)

An LED can utilize its long life only if its heat is properly conducted away from the chip. Usually the significant cooling component is an aluminium profile for which minimum size is specially defined for each LED type.

LEDs are mainly used outdoors e.g. traffic signs and architectural lighting, but the amount of indoor applications is growing relatively quickly.

Recycled Plastic

Durat® is half recycled based solid polyester that is produced by Tonester Oy. The material is very resistant to humidity and extremely durable. The sheets can be used to create, for example, coherent, seamless surfaces (Tonester, Oy, company introduction).
Its main characteristic is a unique and recognizable look which is a combination of smooth surface, recycled plastic chips and strong solid colour.

Durat can be categorized as upcycled material (McDonagh, W, The dictionary of Sustainability) which means that recycling of the material increases its value instead of lowering its grade. Durat can be dematerialized and it is 100 percent recyclable after use.

Durat has been applied to kitchen boards and bathroom furniture until now (Tuominen, U, Tonester Oy, personal communication). Applying Durat-sheet to a lampshade can lead to new methods of utilising the material.

**Recycled Cardboard**

Formfiber AB manufactures office furniture components of fibre cardboard. The cardboard is 95 percent made of recycled paper and it is 100 percent recyclable (Edin A, Formfiber AB, personal communication). The fibre cardboard can be used instead of plywood in variant furniture applications and structures. The cardboard can easily be moulded into formed pieces (Formfiber AB, company introduction). Usually cardboard structures are invisible for the user.

The recyclability can be seen on cardboard’s appearance because the look is similar to recycled paper.

**Figure 5: Bath tub (4)**

**Figure 6: Moulded cardboard**

**Figure 7: Cardboard applications (5)**
Challenges and Delimitations

My challenge in this project was to create a pleasurable and effective lighting with innovative application of the recycled materials. Each aspect of the combination of sustainability, lighting and emotional design as well as user testing were all new design views and methods for me. That is why the project was personally highly challenging.

Both of the chosen recycled materials are produced in sheet or board form and they therefore limited the structures of the finished products. LEDs’ need for cooling profiles raised the level of challenges when designing the structure of the light.
APPROACHES AND METHODS

In this chapter the choice of approaches and methods are introduced which were applied in the design process.

**Approaches**

The design process was led by considering human-centred design from emotional design aspect to provide a proposal of lighting which evokes pleasure in users. The approach supported the sustainable basis of the project - aiming to create lighting that is desired for use over a long period and therefore avoid disposability.

**Human-centered Design**

According to Krippendorff (2006, p.13) there “is a move from the image of humans as having to adapt the technological progress and of designers making adaptation less painful, to the image of humans as able to influence the direction of technological development and of designers as finding ways of supporting diverse practices of living, community, and the sense needed for individuals to feel at home. It is a move towards human-centeredness, the acknowledgement that meaning matters.” The designers’ task has changed in the long run from concentration on aesthetical characteristics to user friendliness and lately to cover all human aspects. It could be said that today’s designer’s task is to adapt new technological innovations into an approachable human shape.

**Emotional Design**

Emotional design, which is considered as a relatively new approach, concentrates on human aspects over usability. There are several theories and approaches to emotional design.

Emotional design approach aims to consider human aspects holistically. The expectations users have for new products have increased. Usability no longer seems to be only an advantage, but a self-evident fact (Jordan 2000). A product’s emotional and symbolic value, its meaning, is what really matters to the user (Utterback et. al 2006); users give meanings to products when interacting with them. The same product can have different meanings to different users.
According to McDonagh (2004) products are not tools with which the user completes tasks - instead products can almost be seen as living objects that people can have relationships with. Products can be interpreted as having different personalities. Interacting with products evoke emotions in their users; happiness, anger, pride or feeling of security.

Design and Emotions

“Consciousness serves as a sentient boundary between stimulation from the external physical or social worlds and the internal bodily world. Emotions are a part of consciousness and reflect the complex interaction of mind and body.” (McDonagh, 2004: 3) Products evoke different feelings depending on the user. A product that is pleasurable to all people is a contradiction in terms, however, there can be found certain shapes, colours or characteristics which evoke pleasurable feelings more often than others.

According to Desmet (cited in McDonagh et al. 2004:10) we have attitudes which are innate or learned and this also affects on what kind of emotions products elicit. Instrumental (facilitate goal achievements), aesthetic (senses), social (things should be), surprise and interest (stimulation) product emotions can be considered as product emotion types. For example surprise product emotions appear in situations when a product has a novel, unexpected feature. But the emotions that elicit surprise are often one-time-only emotions. After being surprised by the novel aspect of a product, it will then be taken for granted and will not elicit emotions.

McDonagh (2004) states that designers should not aim to create products that elicit only pleasant feelings. It is more interesting to design products that elicit simultaneously both positive and negative feelings in user interactions to challenge the users. Therefore a provocative characteristic mixed with pleasing characteristics in a product can possibly make the user experience as a whole more pleasurable.

The Four Pleasure Framework

According to Jordan (2000) pleasure with a product accrues from the relationship between a person and the product. The ‘pleasures’ can be divided to four different categories. The four pleasure framework (The Pursuit of Pleasure, Tiger 1992, cited in Jordan 2000) consists of physio-pleasure, socio-pleasure, psycho-pleasure and ideo-pleasure. Physio-pleasure is defined as a pleasure derived from the sensory organs including e.g. seeing, holding and touching during the interaction. Socio-pleasure is derived from relationships with other people or society. It is connected to cultural and material status. Psycho-pleasure concerns usability, cognitive and emotional reactions when experiencing a product while ideo-pleasure pertains to people’s values.
Applying Theory

The aim was to consider the four pleasure framework and its different levels of pleasures in the design process; starting with ideo-pleasure while defining the concept, then considering socio- and psycho-pleasure while prototyping and paying attention to physio-pleasure throughout the entire process. The framework was used as a tool to consider all these levels when aiming to design a lighting that evokes pleasurable emotions in its users while experiencing it in its defined usage context.

Qualitative Research Approach

Since the aspiration of emotional design aspect is to understand people’s relationships with products holistically and understand the role products play in people’s lives (Jordan 2000), it was a natural progression to implement observations and user interviews in test situations having a rather qualitative research approach than a quantitative. Mirriam (1998, p. 6) states that “qualitative research can reveal how all the parts work together to form a whole”. Qualitative approach was applied to perceive what is essential in the chosen usage context for users who fit to the defined user profile; what sort of characteristics were found important and how should they have worked together to be perceived as a pleasurable user experience as a whole.

Prototyping and Testing with Users Intertwined

Testing with users was intertwined with prototyping in the design process. The approach was applied to get feedback from test users throughout prototyping from early stage mock-ups to more developed prototypes.

Methods

Documenting and Observing Light

A light study was performed at the beginning of the project to understand the essence of light. By documenting by taking photos and observing light in the human environment, information was collected on how light exists around us and what kind of patterns it formulates in natural and urban areas. The aim of the study was to understand the appearance of light to apply the information to create a light with more natural than artificial touch.
Applying Lateral Thinking

According to Edward De Bono (De Bono 1990) there are two ways of thinking; vertical thinking is selective while lateral thinking is generative. Instead of thinking vertically about all the process the aim was to think laterally when brainstorming and generating ideas. Instead of thinking analytically and critically while generating ideas and developing concepts, the intention in this project was to think in a provocative way to welcome outside influences and generate lots of versatile ideas at the first idea generation stage.

Brainstorming Activities

Ideas were generated in different stages of the process: At first stage different possibilities of the chosen materials were surveyed by sketching. At the next stage different conceptual ideas were generated after performing a light study. Few concepts were developed on idea level and finally the two chosen concepts were developed to concrete forms.

Interviewing Possible Users and Tests with Users

First a small group of possible users were interviewed about their expectations of the context of the lighting: What would be the most pleasurable dining situation at home? What kind of adjectives would the users connect with that situation and how would they like to feel in that kind of situation? Once the concept for the design was defined and prototyping could be started the user tests were introduced. The tests were run alongside the development of prototypes to define product characteristics such as amount and tone of the light and also size, shape, colour and finishing of the shade. Testing was run to understand the pleasures connected to the situation in which the products were to be used. The aim was also to test what sorts of characteristics were found pleasurable in the context of use according to test participants. The characteristics which were found most pleasurable were applied to the lightings.

Edward de Bono’s Six Hats Method

The six hat method (de Bono 1985) was applied to user tests to maintain a comprehensive overview of how users felt about the prototypes and their characteristics such as lighting quality, shape of the shade and the atmosphere created. The six hats method was supposed to give the users a framework to convey how they feel about the product while still giving freedom to articulate and emphasize the opinions and feelings that the product evoked.
Identifying User Profile

The user profile was defined to assist when considering emotional aspects while designing the lightings. This defined framework of user's life-style and values was a basis for making design decisions. The design proposal’s characteristics were supposed to meet the values and fit to the life-style of the imaginary user. The participants in set testing situations were people who fit into the defined user profile.
ACTIVITIES AND RESULTS

This chapter will consider descriptions of different stages of the process; how the light study, application of emotional design approach and chosen methods resulted in two lighting proposals.

Defining a User Profile

The imaginary users are a 20 to 40 year-old European university student or a white-collar worker. He lives in an urban environment and enjoys activities and relaxing moments with friends and family after work or while studying, particularly at the weekends. He is worried about global warming but does not know how to live a sustainable life-style without giving up the active and urban life-style which includes e.g. going out, belonging to an athletic club and enjoying the activities of popular culture. But he is trying to consider sustainability when purchasing products or travelling, as long as it does not make life too complicated or involve any major effort.

He does not desire a glamorous life-style but he enjoys a hint of luxury in everyday life. Social status is important rather than trivial to him. He is willing to carry his social responsibility and appreciates people who turn their values into action.

The lighting proposals were designed to please users who fit into this user profile.

First Ideas of Applications of the Materials

The design process was started by sketching in order to find out possibilities for how the chosen materials might be applied to the shade of a lamp. By bending, rolling, folding and cutting into strips, cardboard could be shaped in different forms. The purpose was not to find a shape for a lampshade but to give a spread of possibilities how to apply the chosen materials before starting to generate conceptual ideas of the lightings (See figure 8).

Figure 8: Possibilities of shaping cardboard
Observing Light

Light was studied in an attempt to understand its different qualities. The study was performed observing combinations of natural and artificial light and shadow. Observations were performed both in natural and urban surroundings, indoors and outdoors, by photographing and analysing the resulting pictures; what kind of contrasts, patterns and tones could be found. It was surprising how versatile and multidimensional light appears both indoors and outdoors. Particularly interesting phenomenon which appeared in the woods was strong contrasts between light and shadow; light patterns consist of a great variety of light tones and shapes. Depending on how the LED chips were directed and formed into a lampshade, a variety of outdoors’ light patterns, illuminations or atmospheres could be illustrated indoors.
Figure 11: A variety of light patterns

**Lighting Design Aspect**

An important aspect when designing the lighting was to consider equally the light pattern, amount and quality of light and the lampshade as an object. Lighting is not merely an object, an amount of light or decorative pattern but a combination of all these characteristics together (Jan Ejhed, personal communication while tutoring). Balancing combination of these three dimensions would reduce the possibility of a user experiencing negative surprise product emotions (e.g. simple and peaceful shape combined to aggressive and strong light could be perceived as unbalanced). This aspect was particularly important when the purpose was to create lighting for long-term usage.

The aim was to survey which characteristics (e.g. light patterns and tones) elicit pleasurable feelings in users and then apply the results to create a harmonious entity. In addition to a harmonious combination of pleasurable features, the intention was to add a touch of provoking aspect to challenge the user; a subtle index or sign in the appearance of the lighting can raise questions or awaken the user’s interest.

Performing the light study gave an input to start the design process concentrating on the light pattern instead of the lampshade or quality of light.
**Ideo-pleasure**

The design process’ theoretical framework was to apply Jordan’s (2000) view of four pleasures to pay attention and consider all the different levels of pleasures while defining the product characteristics aiming to create a pleasurable lighting experience.

The first category to be considered of the four pleasure framework was ideo-pleasure. It was considered to maintain and to capture an ideological meaning into the product that correlates with the user’s values. Even though distinguishing product characteristics to fit into a one pleasure level (of the four pleasures framework) is in some cases impossible because many product characteristics can elicit emotions of e.g. socio-pleasure and physio-pleasure levels simultaneously. However, concentrating on one level of pleasure at a time could help in reaching the creation of a pleasurable product.

**Emotional Responses in Product Interaction**

Spillers (experience dynamics blog) states that changes in emotional response before, during and after product interactions are important to note when identifying design characteristics. When it comes to lighting, the perception of the lampshade and its lighting properties and their combination can each evoke different emotional responses in the user. In emotional design one approach is to reach balance between functionality, appearance and interaction etc. If an aesthetically pleasurable appearance does not meet good functionality or a product with peaceful appearance works aggressively, the entire experiment results as being unsatisfactory. The aim in this process was to reach to create a harmonious combination of different product qualities in addition to aesthetics (physio-pleasure) and usability (psycho-pleasure) the levels of socio- and ideo-pleasures should all meet each other. Because of the ideological starting point of the whole process, ideo-pleasures were emphasized at each design stage. Particularly significant was that the underpinning idea of the form language would be in harmony with the sustainable starting point of the process - not to deceive user.

**Idea Generation**

Inspired by the light study carried out previously, the design process was started by brainstorming light patterns. Light patterns decorate spaces and can have a significant role in light’s appearance. Therefore its role in eliciting emotions in users is important. The first brainstorming session was a trial to consciously think laterally and to generate ideas without aiming to create reasonable solutions. Ideas were emphasized on conceptual level aiming to connect them with the imaginary user’s values. As an outcome of the brainstorming four different concepts were defined on the idea level: Shadows
in the woods; a living shade - a plant as a shade; a company - a shadow of a person; and a roadmap pattern telling a story when decorating a room.

Analysing One of the Chosen Concept - Maps

The concept of maps was chosen because maps can be interpreted as having a great variety of meanings and therefore there existed a variety of possibilities to reach the product’s ideo-pleasure level. Maps can be interpreted as images of reality. They represent streets, cities, countries and continents. Maps embody patterns which are formed during centuries or millennia. Manmade patterns in our environment are consequences of people living their lives and travelling around; paths, buildings and other parts of our infrastructures. There exist an undefined number of shapes, patterns and signs found in maps depending on the chosen scale.

Instead of products, architecture is usually attached firmly to its unique surroundings; buildings belong to one exact place. A product instead does not usually belong to any specific building or place. Products are supposed to fit many different surroundings.

A product which includes a reference to a certain place in the shape of a map connects the product to that place, even if the product is meant to be spread to many surroundings. A map can be considered to be a sign which indicates that this specific product is somehow connected to a certain place. It has roots or an origin that can be recognized.
Developing Further the Chosen Concept

At this stage the purpose was to find a meaningful shape that could possibly tell a story or provide a piece of information about the world; symbolic characteristics intertwined in the shape of the product. Lateral thinking was tried in an attempt to spread out a variety of approaches to the chosen concept. Generation of versatile ideas was supposed to be applied to the shape of a lampshade.

Origin

One of the ideas concerned roads and city maps: In today’s globalised world the origins of people as well as the origins of products are not that unambiguous. The information of a product’s origin might not even be available. Ideas were generated to find a clear way to express the thought of origins embodied in a certain characteristic to define a shape for the lamp.

Continents

One of the ideas concerned continents; movements of tectonic plates could be applied to the shape of lighting to symbolize globalization, the integration of the whole world. The dance of the continents was one of the topics considered as an inspiration source to find a ruling characteristic for the lamp; could a sketch of the future continents be applied to a shape which refers to it?

Glacial Retreat

One of the ideas based on glacial retreat; Global warming undeniably affects on our ecosystems and there might be no ice in the Arctic in summer by 2100 (Amos, J, BBC News).

Glaciers were found as a great inspiration source when generating ideas of lampshades. Their exotic and austere circumstances combined with their beautiful variable landscape can be perceived almost as myths.
Applications of these ideas opened a possibility to add a challenging characteristic into the design proposal to raise emotional satisfaction in users when interacting with the created product. A certain characteristic of a lamp, which users can interpret as something meaningful or e.g. perceive it as a reference to a story, affects also directly on the product’s socio-pleasure level. A product can e.g. either refer to a subculture that the user represents or raise the user’s status and thereby affect his social relationships. A product which is based on an ethical idea can evoke pleasurable emotions in its users; to make them feel a better person. The aim was to concentrate on creating lighting where appearance is based on an ethical idea to consider both socio- and ideo-pleasure levels.

Prototyping and Testing with Users

Tests with users were run from the early mock-up stage. Testing situations were set to find out if the mock-ups were perceived pleasing or not. Feedback from respondents was applied to develop the models further on.

Developing Ideas to Concrete Forms

After exploring different approaches to the chosen concept and generating ideas, two shapes were developed to concrete forms. A map of a town symbolising the importance of people’s origins, was applied to an extruded shape of its borders.
To find pleasurable proportions and characteristics several 3D-models were sketched for user tests. A map of Antarctica was also extruded and swelled and cut into pieces to define the lamp's appearance to a more aesthetically pleasurable one (according to respondents) and thereby to reach the level of physio-pleasure. In this case vision was the only one of sense which was considered when aiming at creating a pleasurable lighting experience because the intention was not to create a lamp that is for holding or touching.

The Context of Use

The intention was that the lighting should be a ceiling light, to be placed above dining table. It was meant to fit into and support a dining situation by enabling a pleasant atmosphere around a table.

Users’ Expectations or Vision of Pleasurable Dining Situation

According to Wensveen’s three steps method proposal for affective design consists of three steps (Wensveen et al. studiolab). The first step of the method concerns relevant emotional aspects for a context for experience. To understand what kind of dining experience is pleasing a group of possible users were interviewed who fit into the defined user profile.
Users were asked to describe what they associate with a pleasant dining situation in a home environment; what kind of atmosphere they found as desirable. Surprisingly almost without exception the group of people who were interviewed agreed that an ideal dining situation should be calm, cosy, social, relaxing, comfortable warm atmosphere. They preferred to share the situation with friends and family. The descriptions included opinions about lighting even though it was not mentioned as a consideration. According to possible users dining lighting should rather be dim than bright. This point of view was applied when defining the amount of light in created lamps.

Testing with Users

As soon as the prototyping was started the user tests were run to examine ideas and product characteristics. This was done to understand what kind of feelings they elicit in users who fit to the defined user profile. The tests consisted of interviews in framed use situations. Users were either asked to articulate their feelings about mock-ups or early stage prototypes to find out which characteristics they find as pleasurable and why by showing them different product alternatives e.g. sizes, colours, shapes, light tones and atmosphere. The tests were run four times during the process with five to twelve participants at each stage. Most of the test situations were set for one to three users at a time.

Results of Testing with Users

Users did not naturally agree on many occasions when interviewed about what is and what is not pleasurable dining lighting in the usage context. However some characteristics, light tones and shapes were found more pleasurable than others. As a summary warm light tone, soft light patterns on a table and ceiling were agreed to be pleasant. Soft shapes, light weighted appearance and interesting shapes evoked pleasurable feelings in users. In the test situation another thing which also came up was that kitchen or living room’s ceiling lamps are desired to be conspicuous and eye-catching compared to other light sources in the home environment. Unwanted lighting features were sharp edges in lamp shade, strong reflections, hard light, cold light tone and heavy structures. These characteristics made users feel scared, awkward or reserved.

The kitchen or living room ceiling lamp is desired to have characteristics and look interesting and illuminate the room with versatile patterns and at the same time create a cosy and calm atmosphere.
The shapes of lampshades challenge the user to be curious to know where the shapes come from. Even thought the concept was developed to express and symbolise certain thoughts, the signs and symbols which can be found in the shapes, can be interpreted in several ways. The shapes can easily be related to nature because of their organic shape language. Possibly the shapes can be associated with geography and the specialists of that field can even be able to recognize the origins of the forms.

![Figure 24: Light pattern](image)

**Finalizing Product Characteristics**

Final product characteristics were defined mainly according to the results of user tests to combine features that evoked positive feelings associated with the dining situation.

**Town**

**Form, Colour and Finishing**

The shape of the shade is based on borders of a town called Turku in southern Finland. The shape was developed to a calmer direction. Instead of angles and sharp corners and multiple cuttings the shape was finalized to be simple, soft and a curvy flat form. A roadmap of Turku creates a pattern underneath the lighting. When the lamp is placed above a table the pattern can be seen slightly on the surface of the table.

![Figure 26: Map of Turku](image)

![Figure 27: Sketches of town](image)
Upcycling Recycled Cardboard

User interviews were carried out where they were asked to judge shapes and materials. Plain recycled cardboard was perceived as uncomfortable and miserable rather than happy or social. The appearance of the material had to be upcycled to promote its physio- and socio-pleasure levels.

Several actions were made to found a way to upgrade its image. After testing painted, laminated and covered versions the most pleasurable solution - according to users - was to laminate the plain cardboard sheet with thin darker toned layer. Thick layers got easily wrinkled so the best quality finishing was achieved with two sheets of thicker light toned sheets attached to a dark toned sheet. As a solution its look was promoted and the material was still recognisable which supports its environmentally friendly image.
Figure 30: Final characteristics of Town

Figure 31: Defining the shape of Antarctica
Form, Colour and Finishing

Final features defined for Antarctica were spaces between the layers to let more light out to create interesting patterns in the space and achieve a lightweight, floating appearance. In addition to two LEDs directed downwards an LED chip is directed to the ceiling to create a soft lighting also upwards and a shadow showing a melted piece of Antarctica on the ceiling. The shadow could be perceived at the same time visually calming but ideologically threatening to challenge the user.

A white toned Durat sheet was used in Antarctica’s shade because it reminds ice and snow and the light glows through it showing its transparent recycled plastic chips.
Cooling Profiles

Since cooling profiles are a significant part of LED lighting, it had to be adapted to the lamps. A natural solution was to form the cooling part to be the supporting structure of the lighting. A certain amount of aluminium sheet was applied to the shade to cool down the LEDs to a maximum temperature of 35 degree Celsius to guarantee its long life in standard indoor circumstances. Cooling profiles for each lamp were designed aiming to create a simple and functional metal component.

Because of cooling profiles' simple fastening, both of the lamps are easy to dismantle after use and all the components apart from electric parts are easy to recycle.
Amount and Tone of Light

Psycho-pleasure aspect concerns usability of a product. In this context usability is connected to the amount and the tone of the light; how the user experiences the functionality of the light in its use context.

At one stage the plan was to take advantage of the LED’s particularity that is the variety of colour tones. The idea was to up-light the ceiling with a different tone than the table but according to user tests it was not found pleasurable for the home environment. The warm tone, which is 3000 Kelvin’s, was found to be the most pleasurable. Warm toned light was experienced as being the cosiest and the best suited in the dining context. White tone was associated with work surroundings and blue light was perceived as cold and unpleasant in the defined use context.

Users preferred to have the ceiling lit up also. In the final product, two warm tone LEDs were directed downwards and one LED with a sandblasted lens was directed to the ceiling to light it up softly.

Both of the design proposals were supposed to create a pleasurable atmosphere around a dining table while separating the party around the table from the rest of the space. Each of the shades confines a warm toned light area underneath them and lights up the ceiling softly to give a feeling of space.
Results - Antarctica and Town

As a result of the process two lighting proposals were designed. Both products turned out to be silent statements of today's globalised world; Antarctica refers to glacial retreat while Town symbolises the importance of people’s own origin in this globalised world.

Figure 40: Melting Antarctica

Figure 39: Town
DISCUSSION

**Methods**

The choice of methodology proved to be appropriate. The application of the four pleasure framework helped consideration of product characteristics beyond usability. User tests supported the process and were a source of input to be applied to the lighting; designing products as a collective transaction instead of a solo project. I certainly believe that users’ feedback enabled me to create a more pleasing lighting than could have been created only according to my own personal judgements. Testing ideas along the process is an inspiring input and the quality of my own ideas was tested all the way during the process. When aiming to create a pleasurable product it is particularly important that it pleases other people and not only the designer himself...

The six hats method especially helped the users to articulate comprehensively their feelings about prototypes in context of use. This in turn helped me to understand better the kind of user experience, atmosphere and characteristics which would gather them under the created lighting while wishing to enjoy dinner at home while, at the same time, making them feel cosy and proud of their lighting.

The only weakness in the choice of respondents was that almost all of them were design students. It may have affected the point of view they were experiencing and analyzing the products in context of use both in their positive and negative viewpoint; as becoming designers they could have taken the attitude of a designer rather than that of a user in testing situations.

Running user tests as an amateur complicated my designer’s role when judging different possibilities – how should a designer follow his or her own opinions when applying results of user tests? In this project my solution was to concentrate on the big picture and trust my own ability to make design decisions when respondents did not agree with each other. If an idea that was excellent from my point of view was rejected by respondents I forced myself to abandon the idea and started to look for new possibilities.

**Emotional Design Approach**

Since emotional design is considered a fairly new approach it was difficult to grasp the matter because it is still establishing itself. There are many different theories of emotion and design and some of them seem to be contradictory. On the Internet I found plenty of information about it but as a novice it was difficult to distinguish what was helpful material.
I perceived emotional design as a relatively abstract approach to design because there is neither absolute truth about pleasures nor experiences and characteristics that evokes pleasure in all the people. Everybody experiences interaction with products differently. That is why I concentrated on finding regularities of pleasurable product characteristics and transforming them into concrete characteristics.

I found the four pleasure framework a very useful tool when considering emotional aspects of the two lighting proposals while designing them. The separation of product pleasures into four distinctive levels enabled me to consider one level at a time more comprehensively without ignoring any of the levels of pleasures.

At some point my attitude towards pleasurable design approach became critical. Are we aiming at having such pleasurable relationships with products that those relationships could replace relationships with human beings? Or is it an approach that aims to manipulate users? Another question that rose in my mind was: Can pleasurable products really increase wellbeing in the long run or do they give only transitory pleasure that leads to unhealthy habits, obsessions or addictions like some entertainment products do? Aiming to create pleasurable lighting may not mean ongoing wellbeing effects in long term use. How can we avoid the disposable effects of pleasure?

**Process**

I had difficulties staying within schedule which postponed the process and resulted in having to speed up at the end. Gathering information of emotional design, lighting design and LEDs took much more time than I estimated when planning the schedule for the project. At times I was struggling to handle all the new design views and topics and did not know how to balance them. I felt that I simultaneously wanted to move ahead in every direction (360 degrees), particularly at the very beginning of the process. That was why I tried not to rush in at the early stage of the process to clarify to myself how to reach each set target.

However, at the end of the process, each aspect had a natural position. Sustainability was the starting point, emotional design view was the leading theory, testing with users the development method and pleasurable lighting the main aim.

**Delimitations**

This project included many personal challenges. To be introduced to all these new topics and find relevant information about each of them, e.g. lighting design, LEDs and emotional design, took a lot of time and effort. I could have limited the topic more at the beginning of the process instead of spreading it
even wider along the way, ending up concentrating on two design proposals instead of only one. Concentrating on one material and one design proposal might have resulted in a more complete prototype.

**Lighting Design**

During the process I found lighting design very challenging. Previously I saw lamps as objects that are supposed to be efficient light sources rather than components of interiors that create an atmosphere. At the beginning the idea was to design a main light source for a room rather than decorative lighting. The results appeared to be something between.

Somehow it was difficult to abandon the idea that a ceiling lamp consists of a bulb and a shade when designing a LED light. Instead of iconic incandescent bulbs, which are usually visible and peculiar part of a lamp that spreads light to every direction, LED chips, which are particularly small components for directing light, are rather components to be hidden than shown.

Performing the light study made me realize all the light tones that exist around us; and that they have an affect on people’s behaviour as well as wellbeing. That opened a new sight for me and now I consider light as a dimension of all the different fields of design – without light nothing can be seen.

**Sustainability**

“Sustainability is not about filling a house with ecogadgets. It is concerned more with designing for the benign biointegration; what the factors, aspects, affects and influences are. Ecodesign is still in its infancy.” (Ken Yeang, Ecodesign, 2006) This thought of Yeang made me wonder if my topic was sustainable only superficially. The idea of promoting the use of recycled materials could have been a step backwards when I was trying to cross the Rubicon to step forward to the field of sustainability.

**Material Choice**

When I reached the information LEDs needing an aluminium profile for cooling, I wondered if it was sustainable to use other materials in the lampshade, instead of aluminium, even if they were recycled. After all, the amount of metal needed for cooling was not vast, and I found upgrading of recycled materials as an important step on the way to obtain closed loop production. Nevertheless, aluminium along other significant components could be recycled as well.
Future Work

The created prototypes are still in their early stage, but it can easily been seen what improvements need to be made to take the two products to the next level. Supporting structures of the lamps could be developed to fit lampshades better. The prototypes would need a lot of development before they could be launched onto the market. Both of the shades could be manufactured, but cooling profiles which are also the supporting structures of the lamps should be developed to fit more smoothly to the entity.

Even though if the prototypes had been developed to their final stage, they would not be considered as realistic products at the moment because high power LEDs are not affordable enough to be released onto the market (Andersson, T, Zero, personal communication). In theory fast developing and emerging LED technology might enable the two design proposals to be developed, finalised and launched onto market in a couple of years time.
CONCLUSIONS

The chosen topic was the result of several months of nurturing how to harness my effort as a designer to support sustainable development; how to start considering sustainability rather as a self-evident fact than as an opportunity of a design process.

The rather experimental design project was highly challenging and after processing it throughout I am happy with its results. Two lighting proposals were designed, and in addition to these objects, important information was adapted, new design methods and approaches were applied and experience of cooperating with companies simultaneously from different fields was gained. Now it is time to look for the next project to apply the methods and approaches learned here to a higher level when aiming to become a designer with a clear conscience.
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(6) Figure 17: Dance of continents (pangea-continental-drift) Retrieved March 6, 2008 from http://geology.com/pangea-continental-drift.gif

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