Textile Disobedience
When textile patterns start to interact

Linda Worbin
The Swedish School of Textiles, THS
University College of Borås, Sweden
E-mail: linda.worbin@hb.se

Department of Computer Science and Engineering
Chalmers University of Technology, Gothenburg, Sweden

In this paper we look into the future of textile patterns in relation to so called Smart Textiles; textiles with qualities adapting to the environment, change colour, send signals, transform and change shape etc.
We show a series of experimental prototypes within the theme of Textile Disobedience; textile patterns that do not really behave as we are used to. In accompanying reflections we discuss technical and aesthetical issues of a more general interest. These experiments include textile patterns that can change from stripes into squares (depending on power on/off) and patterns with hidden messages to search and reveal for the user. The materials used are both Smart Textiles materials like thermo-chromic ink (a material reacting with a change of colour when heated) and a different conductive and heat emitting materials, as well as traditional textile techniques and materials.
By working with Smart textile and learn about their extended properties one learn both about new material but also extend the knowledge about more familiar material and use. The new material helps to think, re-think.
The intention of this work is to develop textile design where new types of materials and techniques bring us to the border between traditional textile design and the area of interaction design, Smart Textile materials open up for a new way of creating and thus *using* the aesthetic pattern.

What happens when a decoration starts to interact?

The textile area is slowly changing due to the introduction of a new range of textile materials, so called Smart Textiles. Within this area new types of textile materials are presently introduced; it can be conductive textile materials, colour-changing materials that react to environmental stimuli, or various shape memory materials. This development of materials within the area of Smart Textiles opens up for new ways of creating aesthetic patterns. This project deals with a strong curiosity over designing with new materials. The intention is to raise questions of how we may or may not use and design textile patterns and decorations in the future.

Linda Worbin is currently a PhD student in Smart Textiles and Interaction Design at the Swedish School of Textiles, THS, University College of Borås in cooperation with the Department of Computer Science and Engineering at Chalmers University of Technology.
She is developing working prototypes of dynamically changing textile patterns to extend understanding the usage and aesthetics of textile patterns in the area of Smart Textiles.

The types of experiments presented in this article are experimental designs using methodological component in a practice-based design research on textile design in the area of Smart Textiles. We work with systematic creation to exemplify different kinds of textile patterns where both aesthetics and materiality are emphasized, in order to make basic textile pattern characteristics even more distinct and visible.

Traditional textile patterns made of well known designers like William Morris, Josef Frank or Astrid Sampe were made with the intention to stay "static". The printed pattern was meant to be in the same shape and colour as the original design drawing. Both now and then design did follow trends and values in society. Morris is proposing that he made textile as well as wallpaper designs to be able to decorate his medieval inspired house. What he did was creating retro inspired design to achieve an atmosphere from an earlier time.

Projects concerning the development of Smart Textiles have been going on for some years now and one of the most important projects for the area of dynamic textile patterns is the work E-broidery: Design and fabrication of textile-based computing. (Post, 2000). The project investigates conductivity in textiles by building a range of different prototypes. To mention some of the prototypes there is the Electronic Tablecloth. It is a tablecloth whit sensors on the surface that invites users to interact with a computer, and whit other people through an interactive piece of furniture. Another is the Music Jacket whit embroidered buttons and circuits onto the jacket fabric that allow the user to play music. In this example the technology is applied onto an already existing object. Other projects in the work are called; Row and column fabric keyboard, Firefly Dress, Music Balls and No Soap Radio. These projects are (from a textile designers perspective) focusing on how to pick up signals and transmit them into textile material. This seems to be the first documented project not showing how to build electronically circuits but how to fabricate (weave or embroider) them.
There are nowadays some commercial companies building on this knowledge. They are producing textiles with electronics integrated directly in the fabric. For example there is a mobile phone made at the company Elexen (1), that is a mobile phone made out of fabric (not totally) but the phone contains a conductive textile keyboard. Another project concerning dynamic textile pattern, is a project made at International Fashion Machines (2), their product Pending Electric Plaid is an art piece that "changes colour like a computer display" made as wall hangings that can change colour and pattern over time. There are also projects with dynamic textile patterns that never change back to its origin look. One example is a bag made by Fashion Victims (3) where the textile pattern is made from leaking ink stored inside a bag.

So, what happens when decoration starts to interact? By looking at the mentioned examples, a dynamic decoration gets an extended use. Many existing dynamic patterns change from one to another, and there is still a range of unexplored ways in the making of dynamic textile pattern. This will be further presented in a basic way, starting with a look at the traditions of making textile patterns.

Is it always wrong to do wrong?

The textile industry (most often) strive for knowing exact what colour and shape that will appear on the fabric, for how long time the colour will stay and for how many washes. This is important to know in advance. When making sketches for an industrially made print or weave the design already needs to be decided and planned in detail long before making the actual item. But sometimes the fabric does not turn out to be what the designer thought it would be. Sometimes it can be an expensive mistakes or it can turn out to be a fantastic development.
It is not always wrong to do the wrong thing. In being able to take part during the production process and learn about limitations, one can take part and develop. A common way is unfortunately that a design for a fabric is draw by hand on paper or using a computer. Then the design is left to another person in the producing process. This can be compared with the way to work in handcraft, when you

work with your design and can follow the material and the tools that are used in a totally different way and take advantage of a mistake. Because we have such an extensive knowledge from the industry of screen printing it often works rather well to translate a design from paper to fabric, but what about new smart materials with unknown properties? When it comes to a material that neither the designers nor the manufacturer have knowledge of it does not work in that way. Neither do we have knowledge about what these materials can offer us that the more traditional cant. To be able to develop new kinds of designs and fabrics in smart textiles it is of great importance to work in an experimental way and take advantage of the "mistakes". The prototypes that will be presented in this article are made in close conjunction with a handicraft studio work and some parts are made close to industrial processes.

Today, it is of great importance to work with a more experimental approach to the industry to be able to find a fitting way of using our knowledge and development in a range of different fields. We are just in the beginning of a new era of textiles. The so-called Smart Textiles are to create a new discipline. Textiles that formerly have been separated from computational technology are now together opening up for a new paradigm in textiles. Nowadays combinations of textiles and computational technology are, in the making of fabrics, a tool for design and way of speeding up production. But now the computational technology is attempted to be an active part even after the production, it will be a part of the fabric during use.
To be able to use and create fabrics in this new textile era it is important to do basic research in the making of textile patterns to be able to understand what new possibilities is offered today, and extend these. Not to forget to take advantages of mistakes.

Textile Disobedience

The project Textile Disobedience started with looking at the obvious in decorations, and trying to understand what the objects or/and decorations actually are doing. As well as what we humans are doing with them. By making the invisible visible, new ideas appeared. To give one example, a tablecloth was made with an extreme decoration on top, made in swell paint, so the use of a piece of fabric to place porcelain on top was almost impossible. It turned out to be a tablecloth that prohibits the placing of small items that need to be standing up.

The theme Textile Disobedience gave inspiration to a certain approach to handling and creating textile patterns. Questions during the process have been about use, misuse and anti use, to highlight specific details of how we use textiles and these eventually decorations. The intention was to learn about traditional decorations and textiles properties, to be able to further extend the use of the new so-called Smart Textiles.

Our movements, impressions and feelings are in a way programmed (learned). Our pre-understanding for objects makes us use them in different ways, how you do depends on many different aspects, social and cultural. Thoughts and ideas about objects that do or do not do what is expected are presented in Hertzial Tales (Dunne, 1999). It is in many ways fruitful to question how we use different types of objects and services in a time like ours, just like in all the past times. In our time the "new" technology is driven by computational technology. With that, all other areas are further developed from our new perspectives, for better or worse, as always.

One source of inspiration is "do-it-yourself" pictures by Andy Warhol and paint by number drawing books. The idea with that kind of paintings is to engage the user to do something by themselves, an invitation to engagement and action. These are interesting properties to bring into textiles, both in order to make people a part of creating a textile pattern (after it is produced) and to add a non static decoration to a textile. Today textiles are relatively cheap and material used to quickly change an environment. Cheap mass-produced textiles are unfortunately about to make textile tradition loose its former status through commercial interests in producing many different decorations and encouraging consumers to buy something new, to fulfil the need of a change.

Textile design is often about function or an aesthetic decoration. One need is placed in the first range of priorities. When buying a curtain, first priorities is many times about what kind of decoration to choose to your existing taste in home decoration, you may even get a separate roller blind just to block out the sun light. But happily this is to be a passing trend, just like form and function became one, or didn't it? Can we start to talk about “aesthetic expression and computation” in the same way?

By making a number of design examples of both dynamic and static textile patterns, both properties in the material and in the design of the pattern has been investigated. A decorative dynamic textile pattern involves more than a static decoration. Its ability to change it will involve two or more expressions.

What is a decoration and how do we act in relation to it? By reflecting upon how we use and create textile patterns and stirving to illustrate the “invisible obvious” knowledge, some first experiment were made. In this first stage only “traditional” materials were used. The intentions were to learn more about the “invisible obvious” and then bring that knowledge into new so called smart materials. All prototypes were made in the context of a table, that was a choice made because it is an area that many people have a relation to, it is a historical object and used together with other objects. Tables, tablecloths and porcelain form a system that has been interesting to have as a frame for the experiments.
The tablecloths are called; the FallingCloth, the StructureCloth and the TraditionalCloth.

FallingCloth 2003 is an experiment in how we use decoration to place an object on top of another. In this case it is a tablecloth that is placed onto a table. The decoration on the tablecloth is aesthetically made as an ordinary decoration, and in this case as a decoration hanging as a border around a tablecloth. The decorative border is making/helping you to place the tablecloth in a specific direction on the table, in a symmetrical way. And when you do so with this FallingCloth it will fall to the ground. It is not a very useful tablecloth in that sense. If you want to keep it on the table it needs to be placed in an asymmetric way. This experiment shows what a decoration can actually do, in spite of being a decoration. Most often the decoration makes the user place the tablecloth in a specific way. Thus, the tablecloth informs us, in an unconscious way, to interact with the table trough a decoration. This is of course depending on cultural aspects; if you are familiar using a tablecloth at all, as well as the size of the table in combination with the size of the table.

Figure 1 A

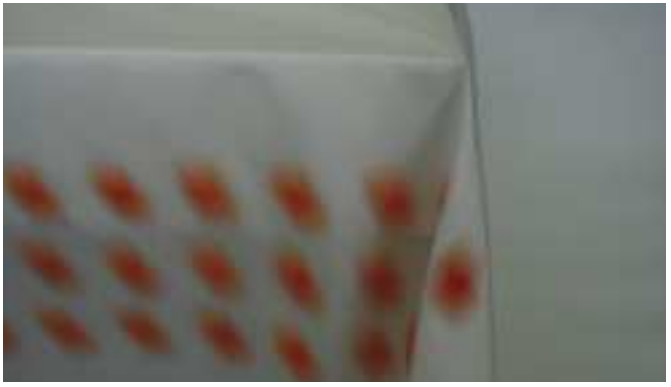

Figure 1 B

Material and techniques: A hand-made textile sketch, using a ready made polyester fabric, silk screen print with pigment and swell paint, textile glue and mosaic. The border is made in swell paint, except in some parts where small mosaic is glued in the same pattern.

Figure 1 C

Figure 1 A FallingCloth placed symmetric on a table
Figure 1 B FallingCloth starts to slide
Figure 1 C FallingCloth falls to the floor

Figure 2 A

Figure 2 B

Figure 2 C

StructureCloth 2003 is another experiment to investigate a decoration. In the Structure cloth the decoration is making the cloth hard to use. A non useful item, can that have a purpose? Yes, I think so. In this example, the decoration is made in swell-paint onto a cotton fabric and gives a rough, plastic and bubbly texture. The decoration is making the traditional use of a tablecloth (to protect a table, or as a decoration) irrelevant. Instead it gives an uncommon structure. This tablecloths decoration does not invite the user to put items on top. Instead, it seams to make people avoid putting stuff on top of the table cloth. This experiment shows what an extended decoration made in swell paint can do; it makes a surface that is changing the use of a tablecloth. In this case, the decoration makes the table cloth hard to use by its rough structure. This tablecloth provides a surface that does not invite one to place small objects that need to be standing up on top of the table.

Material and techniques: A hand-made textile sketch using a ready made cotton fabric, swell paint mixed with pigment.

Figure 2 A A cup balance on the StructureCloth
Figure 2 B StructureCloth seen from above
Figure 2 C StructureCloth close up

TraditionalCloth 2003 is an experiment about the relation between old and new expressions. By using an old traditional tablecloth and make a hand-painted red cross on top it gives a unexpected combination. This experiment deals with what boundaries old object can predict a tablecloth should be ironed and without stains and holes. When adding a red cross on the surface, the old tablecloths contain a gap between the old and the new. We are not used to have unexpected decorations on our tables. We are making a statement with the choice of tablecloth we use, even not using one. By combining more modern materials in traditional constructions or aesthetical agreements a fruitful mixture is to be found.

Material and techniques: A hand-made textile sketch using an old Swedish tablecloth woven in cotton with handpainted pigment colour on top.

Figure 3 A TraditionalCloth close up seen from top
Figure 3 B TraditionalCloth seen from side
Figure 3 C TraditionalCloth seen from corner

Falling, **Structure** and **TraditionCloth** are examples made for reflection over the use and signification of a decoration. Design for reflection, over object and the use of it more than for adding a static extra value. The examples are made using traditional material in a non traditional way. This how material, context and shape of decoration can be used. Today there are Smart Textiles with properties to change depending on surrounding conditions. But it is not only about what material is used, the out come is also depending on the textile construction: if the fabric is woven, knitted or non-woven and also depending of what the fabric will be used for, and in what context. Further on the mentioned examples were used as a starting point to investigate how to develop dynamic textile patterns using so-called Smart Textiles.

Figure 3 A

Figure 3 B

Figure 3 C

Smart Textile

To be able to use smart textile materials in an extended way it is important to understand the making of a fabric, in order to use and develop the inner qualities in the combination of material and construction. It is hard to develop and understand new possibilities in materials (as well as in new techniques) if the two are divided, because the two are so dependent upon each other. New qualities are even created in the meeting between a specific materiality and construction. But at the same time, the two are in a first step developed in different disciplines. For example, the fibre's tear strength gets stronger (or weaker) depending on construction of the final fabric.
Today there is a range of new materials, so-called Smart Textiles, one of many different terms for materials with the ability to adapt or change according to the environment.

For example, there are materials that can change colour depending on sunlight, temperature or pressure. Other materials can be conductive and thus used to transmit signals, be used as a shelter for electromagnetic waves or to create heat.These different material qualities can further be divided into different groups depending on stimuli and response. There is a group of materials called “Chromic materials” that involves materials that can change colour depending on external stimuli and depending on stimuli they can further be divided into subgroups; electro chromic where stimuli is electricity, piezo-chromic where stimuli is pressure, solvate-chromic where stimuli is liquid, photochromic where stimuli is ultra violet light and thermo-chromic where stimuli is heat.

The smart textile materials used in this work are mainly chromic materials and a conductive material. The chromic material investigated in this work is a thermo-chromic ink that change colour due to temperature and is suited for screen printing. A reversible colour change is activated at around 37*C (body temperature) and the colour change last as long as the fabric is heated and then starts to slowly fade away. After the ink is heated up it will stay for some minutes and slowly turn back to its original colour, the time it will take to fade away is depending on temperature. The higher the temperature, the longer it will stay. High temperature during long time makes the fading even slower. Printing thermo-chromic ink can be mixed with “ordinary” textile pigment made for silk screen. There is a range of thermo-chromic ink made for textiles available on the market. Example of the colour range; Cyan, magenta, orange, green and grey. These colours can also be mixed to create new colours. When they are heated up they seem to disappear but leave a gentle shade (the different colours leave a slightly different shade). One can think a bit of different transparent layers when mixing the colours. If no pigment colour is added to the thermo-chromic, the paint will just seem to disappear. But when this thermo-chromic is mixed with “ordinary” pigment that colour will be visible when heated. This will be illustrated and explained further on. This indicates that there is a range of ways to design and mix colours when creating these kinds of textile patterns. Thermo-chromic technique is also available to react in other temperatures.

When screen printing a textile pattern made in thermo-chromic ink and pigment one can either mix the colours and make one print or make a print over another. When mixing the two different pigments, it can be hard to mix “two colours in one”, because the different colours are affecting each other. Ordinary knowledge about how to mix colours can thus be used to achieve different results in the design. For example a blue thermo-chromic and a yellow pigment will turn out to be a green colour, but when heated it will turn into yellow. When mixing the colour the two different possible colours are seen individually, but are affecting one and other.
Screen printed thermo-chromic ink can be washed in 40 degrees and the colour changing affect is to last approximately 20 washes. The material was used a short period during the 1980´s on for example t-shirts and skiers clothes. Nowadays the material is mainly used for cheap commercial products, plastic dolls with hair that changes colour when washes, plastic spoons for children's food and so on. What could this kind of material offer to textile patterns without being addressed like a material used on gimmick products?

The conductive fibre used in this project is a carbon fibre. The carbon is used because of its rather poor conductive properties (compared to metals). Because of the high resistance in carbon fibre heat is produced. Carbon fibre is used in combination with thermo-chromic screen print. Other conductive materials such as metal wire and film have also been used in the experiments in order to create heat.

Experiment / Smart textile

By experimenting with objects closely connected to table-cloths like, porcelain, computers, iron and more, the making of dynamic textile patterns took off. The system of a tablecloth, the act of drinking from a cup filled with hot tea or coffee became important factors for creating a pattern. A stronger connection between objects, how they influence each other, the material in the tablecloth, and the objects on top appeared. The hot objects left a mark on the thermo-chromic treated fabrics.
Other ways of activating thermo-chromic textile pattern are placing heat elements under the fabric and integrate it into the fabric itself. Some experiments have also been made using non-physical objects like hot air fans and hot liquid. In these experiments the thermo-chromic material was used both with and without a range of different colours. Just to learn the material and what kind of colours and patterns that could be made using these materials.

Material and techniques: A hand-made textile sketch using thermo-chromic screen print on cotton fabric.

Figure 4 A A cup with hot water on pink tablecloth
Figure 4 B Hot water spilled out on tablecloth
Figure 4 C The hot water immediately makes a pattern on the tablecloth

Figure 4 A

Figure 4 B

Figure 4 C

Figure 5 A

Figure 5 B

Figure 5 C

Experiments were done looking at different ways of designing textile patterns with thermo-chromic ink. Structures were put onto fabrics. Patterns have been printed on both plain weave and onto already patterned fabric. Then the design of different heat elements was taken into consideration and further developed in the following categories; placed on top, under or integrated in the fabric.

Using heat elements on top of the tablecloth.

"Do the pattern yourself" 2003. A single coloured tablecloth was made out of thermo-chromic screen print and the idea of using external objects to make patterns. No pattern was made onto the fabric, just an over all print was made. Now, the object (the bottom of the cup) is what will make a decoration onto the tablecloth. Actually, the textile decoration can be made on another object and then "stamped" onto the fabric, for example different shapes could be moulded in the bottom of porcelain to create the textile pattern. This textile pattern allows designing one's "own" pattern during usage. Instead of creating a ready-made decoration, we encourage people to take part in the creative process after the fabric is made. By making the tablecloth "do it yourself" the textile pattern starts to do something more than a traditional textile pattern does. The textile pattern that will appear on the surface will look much like a stain from having coffee or tea under your cup. This kind of textile pattern also tells us about an ongoing or earlier activity around the table.

Material and techniques: A hand-made prototype in textile, the fabric is ready made cotton satin with a thermo chromic screen print (using an open screen print frame) water resistant treatment is made on the surface.

Figure 5 A Cups with hot water is placed on the tablecloth "Do the pattern yourself"
Figure 5 B Moving around hot cups on the tablecloth
Figure 5 C "Do the pattern yourself" seen from above when temporary pattern is made

Two coloured woven fabric. Making a single coloured screen print in thermo-chromic onto two different fabrics will of course make a big difference. Some patterns were made onto a two coloured woven fabric, consisting of white and red threads. When making a red thermo-chromic print on top, a small weaving structure will appear in the areas that have been heated. This gave a mixture between old and new expressions that makes connections to, and takes advantages from, old traditions and new materiality. The idea was to keep the “big surprise” when making a pattern with for example your cup but also make a more beautiful fabric. By mixing white and red when weaving the fabric and then print a dark red pattern on top, there will be a mark of the cup but the construction in the fabric will also be visible and be a decorative part.
When designing with this kind of colours one needs to think about the different stages and the two together. This is just like working with more traditional screen prints overlapping each other, but the extra aspect is that the colour now even can change. This makes it even more interesting to work with colours made by mixing different ground colours.

Figure 6 A

Figure 6 B

Figure 6 C

Material and techniques: A woven fabric in read and white with a hand-made thermo-chromic silk screen print on top.

Figure 6 A A fabric printed with thermo-chromic
Figure 6 B The fabric is heated with an iron
Figure 6 C A temporarily colour change take place

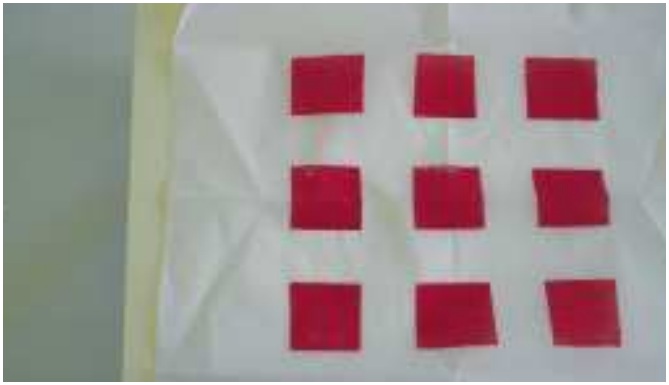

Figure 7 A

Figure 7 B

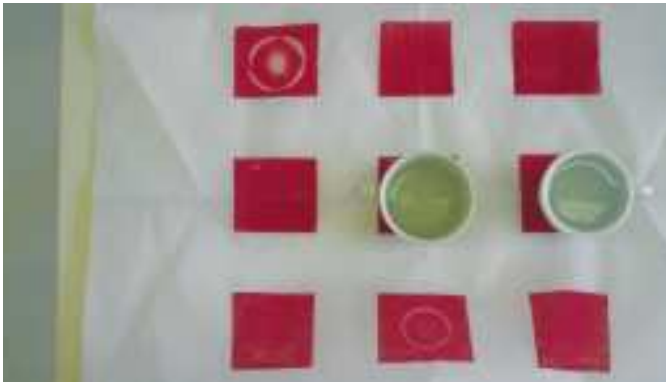

Figure 7 C

Designing a pattern for screen printing. By making different designs one can use the thermo-chromic qualities further. In a pattern with nine squares, that may encourage people around a table to play a tic-tac-toe game, it even gets a time aspect introduced into the game if hot cups are used as play markers. Thus time is an active part in both the (new) rules of the game and in the time you can spend on playing a game. These tablecloths were placed in a café at an office, the intention were to encourage the workers to play as long as their coffee was hot and then go back to work. But what happened was that the tables where much bigger than the tablecloths and people did not want to stain the tablecloths and instead balance the cups on the empty table space.

Material and techniques 2003: A hand-made textile sketch on ready made white cotton fabric, silk screen print on top made in thermo-chromic ink mixed with pigment.

Figure 7 A A tablecloth with a nine square design
Figure 7 B Hot cups are placed on the tablecloth
Figure 7 C When drinking and thus moving the cup a temporarily pattern appears on the squares

Using heat elements under the tablecloth.

Structure. Pleats are made onto a fabric (using an open frame silk screen print in thermo-chromic).The structure opens up for a new perspective, the time. Since heat is rising in the fabric it takes different times and temperatures to activate the whole fabric.

Figure 8 A

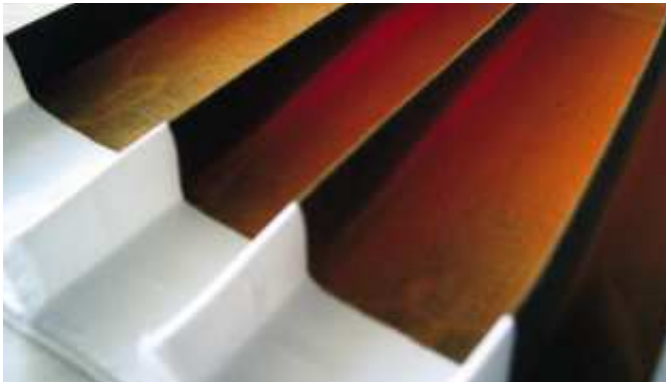

Figure 8 B

Material and techniques: A hand-made textile made in silk screen print on top of a white cotton fabric, thermo-chromic and pigment colour.

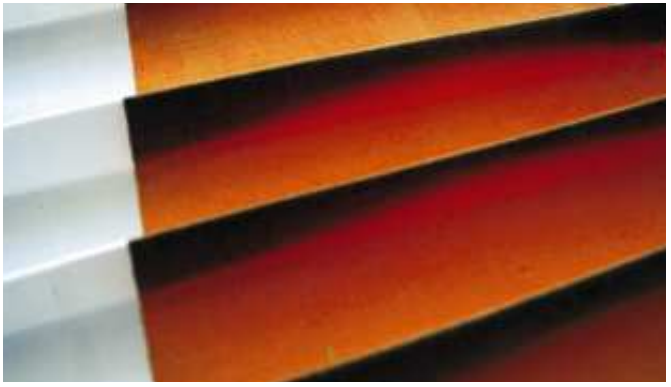

Figure 8 C

Figure 8 A Pleats made on a cotton fabric with a thermo-chromic screen print
Figure 8 B Under the fabric a heat blanket is placed and turned on
Figure 8 C The heat slowly grows up in the pleats and make a temporarily colour change

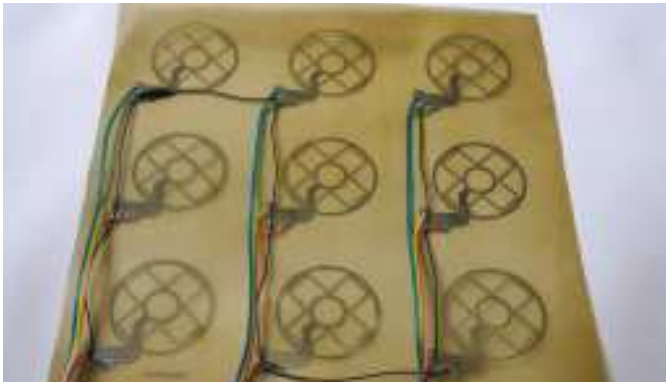

Figure 9 A

Figure 9 B

Figure 9 C

Specially designed heat elements. Heat elements that have been explored in this project are laser cut heat elements, which allows you to control the pattern in a more specific way.
This technique was used in a project called Tic-tac-textile (Ernevi, 2005) the textile pattern on a tablecloth can invite the user to play a game over distance using this dynamic textile pattern.
After making this kind of patterns where hot external objects are used to either create a pattern or reveal a hidden pattern from above, the next step was to hide it underneath the tablecloth. A range of different solutions were tried out. To begin with, a heat pad was placed underneath the fabric. That gave thoughts to make the design with a heat element. Next step was to create simple stripes using heat conductive threads and wires. Material used is Kanthal (4) threads and carbon fibre yarn. The yarn was added on the back of the fabric, embroidered or applied by bonding. Depending on what type of textile pattern you want to make, different yarn/wire is preferable. By placing a specially designed heat element under the fabric a totally invisible textile pattern can be revealed from time to time, all depending of how the heat element is designed.

Material and techniques: A hand-made sketch on an industrial woven fabric, silk screen print with thermochromic ink.

Figure 9 A A special designed heat element consisting cross and circles
Figure 9 B The heat element is placed under a thermochromic table cloth and power is turned on
Figure 9 C Slowly a cross is appearing on the tablecloth

Using heat integrated into a textile.

Weave out of heat elements. When trying different solutions of making patterns with heat, first by external objects and then by making specific shapes and place under the fabric, next step was to integrate the heat element into the fabric. If making a fabric with different patterns woven/knitted into the fabric, one would not need external objects to reveal a textile pattern. Or the two could be combined.
A fabric made out of cotton and carbon fibre was made and on top a print with thermo chromic screen print was made. When the power was turned on, the heat element (the carbon yarn) revealed the paint in the area where the carbon yarn was integrated.

Material and techniques: An industrially woven fabric in cotton and carbon with a hand-made silk screen print out of thermo-chromic ink. In the edges (of the carbon fibre yarn) electricity is added (7 voltages). When the power is turned on the carbon starts to emit heat that affects the thermo-chromic print to change appearance 2004.
Figure 10 A Carbon fibre is integrated in the weave with thermo-chromic screen print on top
Figure 10 B Power is turned on and heat is produced, thus a colour change appears
Figure 10 C Close up on colour change and power supply
By making textile patterns that change dynamically we can view the actual creation of patterns as inherent in the use of textiles. Thus a range of different possible textile patterns can be included in one fabric and changed from time to time. Even after the fabric is made it can be given a range of different textile patterns and expressions depending on how the power is turned on or off, the programming. Thus a new element becomes important; time.
The time the heat element will be programmed to be on is how long time it will take to reveal a pattern (that is depending on, for example, material and construction of the fabric).
To better understand the properties in the thermo-chromic ink, the usage and the aesthetic possibilities, the experiments stayed in the area of tablecloths to take advantage of thoughts from the first experimental tablecloths.

Figure 10 A

Figure 10 B

Figure 10 C

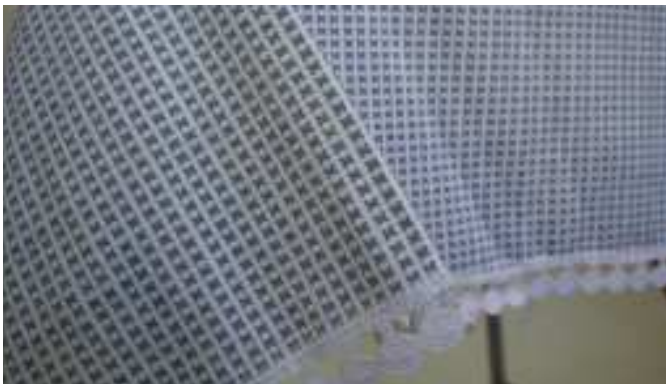

Figure 11 A

Figure 11 B

Figure 11 C

Textile Disobedience / Smart textile

After making the mentioned experiment, next step was to sum up the theme Textile Disobedience and Smart Textile. Two concepts and prototypes will be presented here.

"Rather Boring" 2004. The tablecloth Rather Boring looks like an ordinary, a bit boring, tablecloth. By using the principles of having a hot object on top a textile pattern is revealed. But when hot objects are placed on top the pattern not only seems to disappear; some pattern will actually appear. This experiment shows that by hiding a pattern in another, there will be a feeling of revealing, searching a pattern within a pattern instead of only making a mark with an external object. The design of this tablecloth got inspiration from traditional embroidered tablecloths. By mixing old and new traditions and designs, for example new materials in a traditional construction, an "out standing" look and feeling will not be necessary. Even the surprise in the tablecloth's ability to hide a pattern will give an even a bigger surprise when the design is a bit calm and not screaming for attention. To hide a pattern within a pattern is done by printing with two different pigments but mixed in the same colours (in this case a grey thermo-chromic and a grey pigment colour). It is important to mix the colours perfectly, so the surprise would not be ruined in advance, so the "hidden" pattern can be found before heating some parts. That is a hard task, especially when various light conditions will make the colours reflect differently. Even perfection during screen printing is important in order to get a good result.

Material and techniques: A hand-made prototype onto ready made white cotton satin,
silk screen print made in two colours, one with thermo-chromic and another with ordinary textile pigment.
Figure 11 A Close up on the textile pattern "Rather boring"
Figure 11 B The tablecloth with the textile pattern "Rather boring"
Figure 11 C In the textile pattern a hidden message is revealed using heat

“Being Squared” 2004. This is a textile pattern that can change from striped into checks and back again. The prototype is presented as an apron and a tablecloth, the same fabric is used for the two different items, but with different screen print on top. The tablecloth is given a checked textile print that is static (and made to stay in the same shape over time) and the apron is given a striped pattern that is a dynamic textile pattern. The aprons pattern has got the ability to change into checks when power is turned on, and thus creates the same sized checks as on the tablecloth. Two different (but similar) textile patterns also show the ability to create a kind of camouflage possibility by combining a dynamic textile pattern with a “static” textile pattern.
The principles for creating dynamic textile patterns in this example are by integrating the heat element in the fabric. As shown in earlier examples the thermo- chromic ink will give a feeling of just disappearing when no ordinary pigment is added. This is a simple stated example showing how a pattern can change expression within this technique.

Figure 12 A

Figure 12 B

Material and techniques: Industrial woven fabric (11) in cotton and carbon with a hand-made silk screen print out of thermo-chromic ink. In the edges (of the carbon fibre yarn) electricity is added (7 voltages). When the power is turned on, the carbon starts to emit heat that affects the thermo-chromic print on to change appearance.

Figure 12 C

Figure 12 A The textile pattern “Being square”
Figure 12 B Power is turned on
Figure 12 C Slowly the stripes turns into squares

Looking at the project “being square” one will get range new possibilities when creating dynamically changing patterns. In this case the conductive threads can be seen as different systems with different combinations and intervals. This open ups for a new way of creating different textile patterns after the actual making of the textile. This also brings some parameters that need to be considered in advance. Depending on how many different patterns that is requested to appear (in the same fabric), the making of the pattern can be built up in different ways than is proposed in this article. To clarify the complexity in the creation of dynamic textile pattern one can divide the process in this way;
- Construction of the fabric. If it is woven, knitted, non-woven or i.e a plain fabric? The fabrics construction is the first part of what possible decoration that will appear.
- What materials are the fabric made out of? And what are the properties of the material?
- After treatments, in this case screen printed pattern on the fabric and design of it.
- Time length for the power (sent out in the fabric) to be turned on or off (programming)
- Context and eventually systems.

Using the textile pattern in the future

The title textile disobedience means textile patterns that do not act as we expect them to. They are playing with us and our pre-understanding of what a textile pattern is and show what it can also be like. Dynamic textile patterns can change according to surroundings, “spread” to other items and appear when they are programmed to. This kind of textile patterns with dynamical properties is something that we usually do not connect with textile patterns and their use. Thus it feels a bit like dynamic textile patterns is a bit of disobedience, in a playful way.

The dynamic textile patterns presented in this article are using thermo-chromic material and heat to reveal the pattern. There are a range of other materials that can be used using similar structures for designing dynamic textile patterns. Other dynamic textile patterns have been made in other materials during the making of the prototypes mentioned in this article, for example the Lamp-Curtain. This is a fabric that can be used both as an ordinary curtain to block out light during day and as a lamp when dark during the night. But this dynamic textile pattern tended to be more about a multi-functional tool, a lamp and a curtain, than a dynamic changing pattern.

New smart materials with the ability to change, extend the expressions and open up for a new way to both interact and design with and for familiar objects. Technology components can become the fabric in itself. Thus is no longer a need for technology to be hidden in a shell. Objects can express both technology and the aesthetic within the construction. The intention with this project is to show possibilities in textile materials and techniques, abilities to create a dynamic changing textile patterns as well as to make suggestions by making prototypes illustrating how dynamic textile patterns can be designed. In the future, the programming needs to be further considered and given a larger space in the making of a dynamic textile pattern.
When a decoration starts to interact one may look at textiles as a material with other properties than the ones mentioned earlier. New qualities open up for story telling, expressing ideas, and messages. Dynamic textile pattern, also open for a multi functional use of textiles. Areas for applying dynamic textile pattern can be different, for example camouflage, safety, health care, personal communications, just mention some.
This opens up a totally new area both for computational technology and the textile area. Hopefully textiles will come a bit closer to “aesthetic expression and computation”. Thus the new area for textiles could fulfil the gap between technical textiles and soft furnishings, so instead of being produced as only decorative shells new textiles will contain both aesthetic and communicative aspects.

Acknowledges

Vinnova (the Swedish agency for Innovation Systems) and the Swedish Foundation for Strategic Research through the project Textiles and Computational technology (IT & Textiles) at the Interactive Institute. Thanks to Lars Hallnäs, Mathias Worbin and Marcus Bergman for advice and improvments.

References

Dunne, A. (1999) Hertzian Tales, Electronic products, aesthetic experience and critical design. The Royal College of Art and Anthony Dunne.

Ernevi, A., Eriksson, D., Jacobs, M., Löfgren, U., Mazé, R., Redström, J.,
Thoresson, J. and Worbin, L. (2005). Tic Tac Textiles. Proceedings of
CUMULUS Lisbon 2005, Pride and Pre-Design, The Cultural Heritage and the Science of Design.

Post, E.R., Orth, M., Russo, P.R., Gershenfeld, N. (2000) E-broidery: Design and fabrication of textile-based computing. IBM System Journal, vol 39, pp. 840-860.

Notes

1. Elexen
   http://www.elexen.com

2. IFM International Fashion Machines
   http://www.ifmachines.com/eplaid.html

3. Fashion Victims
   http://www.fashionvictims.org

4. Kanthal is a metal wire used for example in toasters, produced by Kanthal
   http://www.kanthal.com

5. The fabric is made on a jacquard machine, but used as a shaft machine. The construction is two warp treads over one weft insertation.