Contract knit

Explores form possibilities in knitwear through material interactions

Bachelor in Fine Arts: Fashion Design
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Abstract

The focus of this degree work is on material interaction within the field of knitwear. Material combinations are often seen in fashion as a decorative effect to add shine, transparency or blocks of colour. The materials are put together as one flat material.

This work embraces the different qualities and explores the possibilities to use material interaction as a way of creating form on the body.

To achieve this, material experiments have been made to find combinations that had a big impact on each other. The materials that were found to be most suitable for this were the combination of metal and lycra yarn. This combination showed contrast in both volume and in density.

The result is a collection of seven examples that is based from square knitted pieces where the interaction changes the form of the material and the garment.

Creating form from material combination could lead to a new method of creating garments with larger form possibilities than is seen today in ready to wear knitted garments.

Keywords
Knitting, knitwear, fashion design, material interaction, form
Look book

Model/ Sofia K. Modellink
Photographer/ Jan Berg
Introduction to the field

**Knitting**

Knitting is a textile technique where one continuous thread with help of knitting needles or a machine creates loops that together form a textile surface. The technique is based on two kinds of stitches, plain and purl stitch (fig.1). When a stitch is plain on the front side of a fabric it is always purl on the backside and the other way around (Hemschen 1991). The knitted material has the benefit, in contrast to a woven material, to be able to be formed into a garment in any desired shape without need for seams or darts (Ray 2012). This craft has regained its popularity many times during the history. This might be because of its simplicity and that it only requires two needles and one ball of yarn to perform, unlike weaving that demands a loom and more preparation before you can start to create your fabric.

The craft of knitting dates back to around 1000 BC. To create fabric with help of two sticks was then mainly a craft for royal women. Knitting was not seen as a full-time job until men started to knit in the sixteenth century (Ray 2012). The first knitting machine, “The stocking frame” was developed in 1589 by Reverend William Lee (ibid).

The first knitting machine could only knit plain stitches, but when rib came into fashion, the market demand pushed the need for a two bedded machine, and this was developed by Jedediah Strutt in 1758. In the 1776 fashion called for stockings with vertical lines. In order to produce these stockings, wider knitting machines were developed and stripes were knitted horizontal over the needle bed. The knitted pieces were cut in the desired shape in a cut and sew manner (MATKOVIĆ 2010).

Through history there have been periods when the development of the knitting machines depended on the trends in fashion, but there have also been times where the technology has led the way for designers (Power 2007).

In the 1920s Gabrielle Coco Chanel introduced fashionable womenswear in jersey fabric, before that knitted material was mainly used in men’s underwear. She also used style attributes from menswear taking the cardigan from army wear and making it into the classical Chanel jacket (Steele 2010).

**Intarsia knit**

According to Spencer (2001) there are five basic ingredients for knitwear fashion: style, silhouette, texture, pattern and colour. There are many ways of adding a colour design to a knitted piece. Most ways involve a mix of the different yarns since all yarns knit across the whole width of the piece. The threads that are not knitting the pattern either leave a floatation on the back or a knitted backing to avoid loose threads. By making an intarsia pattern one can prevent this. In an intarsia knit the yarn carrier only moves over its own colour area. This means every section of colour, even if several sections have the same colour, needs its own set of yarns (fig.2). To keep the different colour blocks together they are attached with a tuck stitch in the neighbouring block of colour (Raz 1993).

**Material combinations in fashion**

Material combinations are widely seen in fashion as a way to combine different textures, shine, transparency or colour blocks. In this way the material combinations are mainly used as a decoration. The meeting of the materials are often aimed to be perfect and flat. The material should not wrinkle or in any way affect each other. But one can ask oneself what is the point of combining materials if they should act as one?

Calvin Klein’s fall 2014 collection (fig.4) also involves the meeting of materials. Most garments are knitted and some of the pieces contain different gauge knitting but the silhouettes are still not affected by the different materials.

**Motive and idea discussion**

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Antwerp Royal Academy of Fine Arts student Edoardo Rossi (fig.5) has in parts of his bachelor collection used areas of tuck stitches and several different colours to create an uneven surface.

Prada has in the fall 2014 collection (fig.6) combined a fine knit with a heavy knit in wide stripes or blocks. The blocks create clear sections as the heavy material break in the meeting with the fine knit and collapses. The materials are working against each other rather than together.

Chinese knitwear designer Uma Wang has throughout her work a big focus on material combinations. The material of the garments are often divided into two areas where the split is placed somewhere in the middle, horizontal or vertical. The example in fig.7 show a clear break between the two materials even though this is visible, the material does not impact each other dramatically.

Helen Lawrence uses the effect of combining materials in her fall 2015 collection (fig.8). The collection is inspired by the work of the British artist Phyllida Barlow. The result has a raw aesthetic where lamb wool combined with elastic yarn to create volume in the asymmetrical garments. In this work Lawrence uses the volume created between the two materials more as a decoration than a way of creating form.
These examples show material interactions where the decorative aspect is in focus rather than the aspect of form. The first two examples have no effect on the form of the garment. The following examples have little effect on the form. Lawrence has a clear difference between the materials created in the interaction, but in her collection the material interaction is still used as a decoration. All of these examples are lacking in the exploration of form that relates to the material interaction.

Form in knitwear

Maria Blaisse work investigates form and material. Her sculptures or costumes are between the disciplines of art, design, textiles, and fashion. Blaisse often use common materials, for example she has done several pieces from rubber inner tubes from tyres. By placing them on the body she creates an unexpected expression, her work is simple but playful (Blaisse 2013). The example in fig.9 is from the project “Onda” where knitted wool tubes formed in circles are placed on the body. In many of Blaisse’s pieces it is hard to determine whether the form or the body is in control.

Yang and Love (2009) presents in their research a way of creating form in knitwear by combinatory and combining different knitted structures. Landahl’s (2013) research explores a more free way of working with form in knitwear.

The core of the design practice for knitwear lies in the designer accepting a design process where there is only one design parameter, because form, material and making come together as one, with form as a foundation.

Landahl 2013, p.11

Motive

The motive of this work is to embrace the different qualities of materials and let them interact with each other. The work will explore the possibilities to use the shape created in the meeting of the materials and the difference in volume that will occur as a way to form garments. Knitting is a good area for this work because of the ability to combine materials without the need of seams.

Choi and Powell (2005) wrote about the possibilities of three dimensional knitted garments. Even though this technique has been available for two decades it has not yet had a breakthrough on the market, but the technique is forecasted to grow and could be the largest technique in the future (ibid). Three dimensional knitted garments are more and more used within the field of sportswear (fig.10). The technique makes it possible to apply different materials on different parts of the body to create the right condition for a certain sport.

As a secondary motive this work can be a starting point of applying this kind of thinking within fashion where function is not the main focus as in the sportswear industry. Creating form from material combination could lead to a new method of creating garments with larger form possibilities than is seen today in ready to wear knitted garments.

Aim

The aim of this work is to develop form possibilities in knitwear through material interactions.
**Design method and design of experiments**

During the last two decades there has been a debate about research within the field of art and design. Thornquist (2014) argues that:

...practice based design research, is no less theoretic than other research when it comes to the construction of formal syntactic principles and foundational definitions; nor is research in art through art any more practical than research in other fields.

Thornquist 2014, p.53

There are many methods for experimentation but most authors within the area of methodology agree that they are built around the three stages of analysis, synthesis and evaluation (Jones 1992). Jones calls these steps divergence, transformation and convergence and describes them as "breaking the problem into pieces, putting the pieces together in a new way and testing to discover consequences of putting the new arrangement into practice" (ibid, p. 63).

Divergence is the start-up of the design project where Jones (1992) states the importance of keeping a broad and open mind to be able to find a solution to the design problem. It is important that this stage does not focus on speculation but finds all the necessary facts. Another risk in this stage is to project patterns upon discoveries too early (ibid). Bacon (1620) also argues for objective observations in research in his four "Idols of the mind", to be protected from falling into old habits and in that sense not be able to bring science forward.

The second stage, transformation, is the time for experimentation and decision making. Jones (1992, p. 67) describes this as "the stage when objectives, brief, and problem boundaries are fixed, when critical variables are identified, when constraints are recognised, when opportunities are taken and when judgements are made".

The third stage, convergence, is "the stage after the problem has been defined, the variables have been identified and the objectives have been agreed" (Jones 1992, p.68). In this stage one solution is found and tested against the original design problem.

This degree work is performed in a trial-and-error manner. In the beginning a lot of material samples were made to find both the materials and the technique that was suitable for creating form from the material interaction. To not fall into the traps of Bacons (1620) idols these series of experiments were performed without judging the result or having a result in mind. When several series of material experiments were performed the result was analysed to find what qualities of the interaction was successful to be developed further.

In the licentiate thesis "On form thinking in knitwear design" Landahl (2013) explores new methods for form possibilities within the field of knitwear. She argues that knitwear design builds on only one design parameter since form and material is created at the same time. In this matter Landahl describes three possible methods that could be used as a development when designing knitwear. The direction of Landahl’s methods are described as following “The hole, the nothingness of a form”, “The surface, the somethingness of a form” and “The knot, the integration of the inside and outside of a form” (2013, p.48). In the experiment on the “somethingness” Landahl explores how a knitted piece can be transformed by using different kind of stitches without adding or removing any needles to the work i.e. casting on and casting off the same amount of stitches (Landahl 2013). In this degree work Landahl’s thoughts on form in knitwear will partly be applied. But the focus will be in creating form in material combinations rather than by the combination of stitches.

The method of this work is based on that the shape of the garment is created in the material interaction. For this reason increasing or decreasing the number of stitches in the knitted piece will work against the effect of the interaction. When knitting a material without increasing or decreasing, the piece can be described as a square. In fig.11-12 it is visible how the square shaped piece is affected by the different materials.

"Embedded in the material, the form reveals itself”

(Blaisse 2013, p. 146)

When knitting an intarsia pattern on an electronic knitting machine it is possible to change the shape of the lycra in any desired manner. To be able to use these machines the help of a technician is needed. To not be limited by this, all experiments are performed on a hand knitting machine. On the hand knitting machine it is not possible to knit an intarsia pattern, only blocks or squares that extends over the whole needle bed. The knitted pieces can then be sewn together by hand. This will create the same effect as an intarsia knitted piece of fabric. For this reason the lycra parts in the collection are formed as squares. The use of the square in combination with use of colour blocks clearly shows how the garment is affected by the material interaction.

“Research is successful when the basic relationship exists and the most important competing explanations are ruled out” (Koskinen 2011, p. 58)
Development

Material development

Materials combined in a knitting machine
This experiment explores how different material combinations affect each other when knitted together in a hand knitting machine. Materials used are viscose, lurex, monofilament, wool and stainless steel (fig.13).

The conclusion of this experiment is that most of the material combinations does not create a big difference in volume. The difference is mainly tactile and some differ in shine. These differences will not be visible from a distance, for example on a catwalk. Some of the combinations may be useful for complementary garments.

The most successful knitted piece is the metal and viscose combination where the metal creates volume in comparison to the viscose. The materials also have a contrast in opacity. This is created since the piece is knitted in a 1x1rib and the viscose pulls together when removed from the needle bed while the metal stay in the same width as on the needle bed.

Metal combined with materials that contract
This experiment further explores the possibilities of using metal as one of the materials in a material interaction. The metal thread is combined with materials that have constricting qualities that creates a bigger contrast between the volume of the materials (fig.14). The metal is here combined with pemotex, poly/lycra and poly/lycra combined with a polyester yarn. All these materials shrink in contact with heat.

The experiment is performed on 8G and 4G hand knitting machines. Some of the samples were knitted on every other needle and others on every third needle. The contracting material shrinks more when knitted on every third needle than when knitted on every other needle, however both ways leaves the metal in the same width. The two photos on the bottom right in fig. 14 show pieces knitted on every third needle, the other photos show pieces knitted on every other needle. The result differs some in volume but they are both successful and can be used further.

Pemotex shrinks and becomes stiff when in contact with heat. In these pieces both the metal and the pemotex gets a similar stiffness. The materials differ in volume and density where the qualities are contrasting.

The poly/lycra shrinks more than Pemotex and therefore give more volume to the metal. The lycra is elastic in contrast to the metal. The constricting effect is not as big when the lycra is combined with another material, it loses elasticity.

The pieces knitted in 4G get an interesting surface from the bigger stitches, the volume in these pieces are softer but does not hold the shape in the same way as the pieces knitted in 8G.

The combination of several different materials
This experiment combines several different materials unlike previous experiments where only two kinds of materials were tested at the time. Three different qualities were desired in the combination: a material that constricts, a material that create volume and a material that has a soft fall. Materials that were used are Pemotex, poly/lycra, metal, lurex and viscose (fig.15).

This experiment was not successful because the soft material, lurex or viscose, does not really add something more than the previous experiment. The extra material pulls the metal together a little bit but not enough to create an effect like the contracting material.

What was found interesting in this experiment was that the metal acts differently when put together with another thread. It creates a softer shape that is better at holding the volume.
Volume through tuck stitch
This experiment explores how different material combinations affect each other when one of the materials is knitted with a tuck stitch (fig.16). Materials used are lurex, monofilament and wool (fig.17).

The tuck stitches adds extra yarn to each stitch and therefore adds more volume to the material. This gives potential to create volume between materials that did not in previous experiments. The tuck areas gives a fuller expression than a regular stitch. The samples that have tuck stitches in small sections, ribbon like shown in the photo to the right in fig.17, give an interesting surface but do not affect the shape as much as the samples with bigger sections.

Contracting materials and tuck stitch
The effect of the tucked material becomes bigger when combined with a material that constricts, such as poly/lycra. In this experiment the lycra is combined with wool and stainless steel (fig.18).

When the wool is combined with lycra the interaction gives a significant difference in volume compared to the previous tuck experiment. The volume created is successful but both of these materials are solid. Contrast in density is missing in these pieces.

When the metal is knitted in a tuck stitch the material is not given more volume than when knitted in a regular stitch. The effect of the tuck stitch is that the metal parts become less sparse and the contrast in density between the two materials is smaller.

Machine knitting + hand knitting
This experiment combines machine knitting with hand knitting. A piece is knitted on a hand knitting machine and finished with a separation yarn. When removed from the knitting machine the stitches are picked up on a pair of knitting needles. The piece is then continued with a handknitted heavier yarn. Materials used are lurex, monofilament and stainless steel combined with cut jersey fabric, cut woven fabric, felting wool and string yarn (fig.19).

Using this technique gives a big contrast in volume and the material becomes heavy. Even though this is a good way of creating volume the transition between the different size materials is too obvious and needs to be developed further to be used in the collection.

Hand knitted interactions
This experiment combines different hand knitted materials. Materials used are fleece, plastic stripes, wadding, satin ribbon, gift string, string yarn, snilja yarn and stuffed stockings (fig.20).

The samples show interesting thickness and surfaces. The differences between the materials are hard to see with so few stitches but they appear as they are not big enough in these experiments.
Non-knitted material in the knitting machine

This experiment combines non-knitted materials with knitted materials. Materials used are foam, slip protection rug, cotton, wool and poly/lycra (fig.21).

The non-knitted material is hung on the needle bed of the knitting machine and is then knitted as seen in the photos below. The meeting of knitted and non-knitted materials is interesting and could be a project in itself that would need a lot more investigation. For that reason no further experiments will be done in this area.

Silicone knit

This experiment uses a unconventional knitting material to create the shape of a knitted row. Several rows are created and put together as a 1x1 rib. Silicone is the material that is used for this experiment (fig.22).

The result has an interesting hand feel, it is heavy and rubber like. Unfortunately this is not visible from a distance. From far away the material looks like any other knit. Because of this it is not worth the effort of creating this material for this purpose. This material would work better in an exhibition when the viewer would be able to touch the piece.

Inflatable knit

To make the structure of the silicone knitted piece more visible this experiment is made in a bigger scale. A PVC material is welded into the shape of a knitted row that makes the piece inflatable. Several rows are created and put together as a 1x1 rib (fig.23).

The result is interesting but the transparent material makes it hard to see the created structure. The structure is more visible with a dark background than with a light background as visible in the bottom photos of fig.23. The conclusion is that this experiment might as well be for another project and will be put aside for now.
**Intarsia pattern**

As a development from previous experiments with the combination of metal and lycra on page 24, this experiment does not place the lycra in straight lines but as blocks within the knitted piece. This is done with help of an intarsia pattern on an electronic knitting machine.

To be able to knit areas that constrict the metal in any placement, shape or size this experiment gives promising form possibilities. Some examples are shown in fig.26. This kind of pattern is only possible to create on the electronic flat knitting machine. The computer programming can be done single-handed but to produce the knitted pieces on these machines the help of a technician is needed. For this reason it is necessary to find ways of sketching outside this machine that is quick and that can easily be translated into the software of the electronic knitting machine. Fig.24-27 show the making of an intarsia knitted piece, from the programming on the computer to the finished pieces.

**Conclution of material development**

The material development has been made in a broad manner to stay open minded and not having a result in mind. Many interesting combinations where found in the experiments. However, to keep the work focused selections had to be made and many of the experiments where put a side for the future.

The experiments that were found to be successful and that was used in this degree work was the combination of metal yarn and lycra. The first experiment in this material combination is knitted on a hand flatbed knitting machine, shown in fig.28, where the lycra extends over the whole knitted piece. This piece was found interesting since the materials combination has a clear effect on the form of the material. In this piece it is not obvious how the knitted piece is created, which can create an interest from the viewer. As a development of this experiment a piece was knitted in an intarsia pattern on an electronic flatbed knitting machine(fig.29). In this piece the lycra is surrounded with the metal and the form effect is created around the whole knitted piece. As stated in the intarsia chapter on page 14 the access to this machine is limited. For this reason it was tested to create the same effect as the intarsia knitted piece by sewing hand machine knitted pieces together as in fig.30. This was found to be successful since the material gets the same volume and the seam is barely visible. The materials in fig.29 and 30 are the materials that are used in the collection.
Shape development

Below, a selection of the early shape development is shown. In fig.31 the draping is performed on a mannequin with two identical hand machine knitted pieces where the lycra is placed like a ribbon across the middle of the pieces. Placing the lycra under the arm, as in the circled photo, was found to be interesting. This creates the shape of a garment without the need of different pattern pieces or the need of seams. In fig.32 a development of this is shown where more material is added to create a longer silhouette. This toile has good qualities but the expression is not strong enough, the idea of this kind of garment could be developed further.

Fig. 31. Draping with 4 G pieces on a mannequin

Fig. 32. Toile where gathering in the side follows the shape of body

Fig. 33. Draping on body with intarsia knitted pieces

Fig. 34. Draping with intarsia knitted pieces where the aim is for the shape to relate to the body

Drape that relates to the body

In these experiments the lycra is attached to the body/mannequin. By putting the black lycra surface against the body the difference between the voluminous metal and the constricting lycra becomes more visible. The contrast between the flat lycra and the voluminous metal will be more distinct.

In many cases it is not that visible that the lycra is attached to the body. This is because the black colour is compact and does not reflect the light or reveal shades. Also because the dummy underneath is white, the shape might be more clear with a black background. More important than if the lycra is attached to the body or not is how the lycra relates to the body. For example in the draping on the leg and on the arm that are circled in fig.34. The drape in these photos create a shape that follows the shape of the body. A problem in most of the drapings is that the knitted piece is hanging in the attached lycra with no direct way to continue the garment. The garments need to encircle the body more.
Shape development in small scale
This series of experiments are made on a small mannequin to quickly try different shapes and positioning on the body. To mimic the effect of the material interaction of the metal and lycra combinations the fabric is gathered and fusing is added on the area that simulates the flat surface of the lycra (fig. 35).

This way of sketching is quick and creates an overview of how the shape can be placed on the body. Even though some interesting shapes were found, as circled in fig. 36-37, the lycra imitation becomes stiff and is hard to wrap around the body. This quality does not correspond with the real material. Some of the examples that does not work are crossed over. This experiment is not good enough as a sketching method to find form through material interaction as the small scale does not imitate the draping of the real materials. The sketching method need to be developed further in full scale.

Fig. 35. Sewn pieces to illustrate knitted material

Fig. 36. Draping on fourth scale dummy

Fig. 37. Draping on fourth scale dummy
Draping from the tube

In previous experiments the body was not as present as preferred. If one would simplify the shape of the human body one can say that the body consists of tubular geometric shapes (Stecker 1996). In this experiment a tube of circular knitted material was used to encircle the body (fig.39). The material used is a wevenit fabric that is quite stiff to simulate the metal. The fabric is sewn together in a gathered manner with squares in various sizes, a 1x1 rib to simulate the elasticity of the lycra material.

The analysis of the experiment found that the examples where the constricting part are formed as an incision of the tube, rather than the whole way around the tube to be more clear in showing the effect of the material interaction. Some of these examples that were found to be most successful are circled in fig.38 and 40. These examples show the purpose and possibilities of the technique while the shape that is constricted all the way around the body refers to a puffy ball gown, these photos are crossed over in fig.38.

The experiment shows the importance of the squares placements and sizes. For example the long thin square, circled in fig.38, works better when placed on the side than in the front or back. This might be because the square is more adapted to the width of the body from the side. The big shape, circled in fig.40, has an interesting drape when the volume falls from the body. The square is too big since it collapses.

Regarding the shapes where several squares are placed within the same shape. The example where four squares are used is too messy, these photos are also crossed in the bottom left of fig.38. The examples with two squares are more successful especially when placed on opposite side of the garment. However the expression is more clear if only one square is used in each garment.
Composition of volume

The sketches in fig.41 show the possibilities in composition of the garments where the light blocks should be seen as the metal yarn and the dark blocks are seen as lycra. This way of sketching was a quick and useful way to get an overview of the composition of volume but it was lacking in other aspects such as a sense of the material.

On the opposite page full scale sketches are made in the real material to look into size and composition (fig.42-44). Working with the material gives a direct understanding of the way the placement affect the garment as a whole. Even when putting the shapes in Photoshop as in fig.44 and reworking them there, the form understanding is better than in the sketches from fig.41.

Fig. 41. Composition sketched in Illustrator

Fig. 42. Investigation of how to place the volume to get the biggest effect

Fig. 43. Toile of striped garment tried in both directions

Fig. 44. Scale reworked in Photoshop to look into size of garment
Colour
To enhance the form of the garments the choice of colour is most important. A chart was made as an overview of colour options in a light to dark colour scale (fig.45) and in a colour range (fig.46) to investigate when the volume became most visible.

The conclusion of this experiment was that when using dark colours all the way around the lycra, the effect of the interaction is not as visible as when lighter colours are used. The examples that are successful are circled in fig.45. When bright colours are used the shape is clear, but the bright colours themselves attract the eye. For this reason, the use of too many bright colours could take away the focus from the interaction of the materials. All the colours work but the orange tones that are circled in fig.46 highlight the volume created by the lycra in the most successful way. These colours need to be balanced by contrasting colour to find an interesting expression in the collection.

Fig. 45. Investigation on how light/dark colours affect visibility of shaping

Fig. 46. Investigation on how different colours affect visibility of shaping

Stripes and blocks
The form created in the material interaction is clear but to show how the lycra affects the metal even more a block of colour or stripes can be used. The effect of the block is shown in fig.47. In the picture to the left it is possible to see that there is a difference in volume from the gathering around the lycra square, however it is unclear how big the effect is. In the picture to the right the red colour block show exactly how much the lycra changes the silhouette.

In fig.48 the placement and size of the block that extends the lycra across the garment is investigated. It was found that the clearest way to show the effect of the lycra is when the block only builds from the side of the lycra. However, by letting the colour block continue above or below the lycra the eye can be fooled. This might be interesting to bring into the collection in some outfit but not too often to make the concept clear.

The illustrations below (fig.49) investigate how different width of stripes can affect the appearance of the volume. In these examples the garments with the wider stripes are seen as more voluminous than the garments with thin stripes.

Fig. 47. The marked area show the effect from the constricted area

Fig. 48. Investigation on the effect of extending the block above and below the lycra

Fig. 49. Investigation on the effect of using stripes, illustrated on Jil Sanders spring 2011 collection
Colour combination

The orange shade is successful in showing the shape of the interaction (fig.50), however the colour does get too much attention when used in this amount. The brown area looks thinner than the other colour stripes even though they have the same amount of knitted rows. This might be because it is placed in between the bright orange.

As stated before the colours in this collection are important. If the wrong colour is used in connection with the black lycra square the black takes a lot of focus, like a black hole. If the black colour continues as a stripe around the body where the lycra square is placed it becomes clear what the lycra does to the material and shape in the garment as shown in fig.51.

To find colour combinations that were suitable, a lot of tests were performed in the knitting machine and in Photoshop (fig.50-53). Fig.53 shows a colour chart of possible colours to be used in the collection. The colour samples can be removed and tried together in desired combinations. It was found that a mix of contrasting colours, bright and dull, show the shape clearly without getting too much attention.
Lycra

The colours available are black, white and red. In an early stage white was ruled out since the colour was too white and looked cheap. The black and red were kept as options even though the red had less elasticity than the black yarn.

The metal part of the garments has a glimmering effect. Even if the metal is combined with other yarn that add colour, parts of the metal is still visible and glitters. To make the lycra more cohesive with the metal, lurex was added in the lycra in several try-outs (fig.55). When a lurex yarn is added to the lycra it gets the same kind of glitter effect as the metal. In this way the materials can be seen as the same, only that one of them did shrink. This effect works best in the black lycra (fig.56). No lurex was found that was suitable to combine with the red lycra that did not make it look dirty. Also when a full-scale garment was knitted in the red lycra it was not found successful (fig.54). The material looked cheap and the poor elasticity was not acceptable for its purpose.

Transparency

In this degree work it was found that differences in the materials combined are important. The most successful material interactions show a clear difference in volume and density. The difference in density highlights the change of material. When the constricting material has a high density, as the lycra and the material that strive from the lycra is sparse it can be seen as the lycra area has shrunk, this is described in the previous chapter. The transparency of the material does also reveal the body underneath. This shows how the silhouette of the garment is different from the silhouette of the body (fig.57).

Applied example

The materials used in the collection so far show the extreme of the material interaction and the form possibilities that comes from it. One can assume that these materials, or at least the metal, would not work well from a commercial point of view. In this experiment wool is used, instead of the metal, to see if the same type of form can be achieved with the use of a more commercial material.

When knitted in a 1x1rib, with the same stitch as the rest of the collection, the wool does not have more volume than the lycra. To create the same volume the wool is knitted in full cardigan stitch (fig.58), this is the same stitch that was used in previous material experiments on page 26. Colour blocking was tested to be cohesive with the rest of the collection, first in small scale that worked well. When the colour blocking was performed in full scale the line between the two colours became wobbly (fig.59) and not as sharp as the meeting of the colours in the other garments. The wool material made this garment heavier than planned and this made all the elements of it drag down about 10-30 cm. If this garment would be remade all sections should be shorter or another lighter material should be used.

Even if this garment (fig.60) would be developed further the concept will not be as clear as in the garments knitted in lycra and metal. For this reason no further development is performed in this direction during this degree work. However, this first example does show the possibilities for a commercial development using this technique.
Complementary garments
The garments in this work are mostly transparent. This means that what the model is wearing underneath is most important and will be a part of setting the mood for the collection. A series of photographs were taken to investigate how different kinds of undergarments will affect the expression of a garment (fig.61).

Using colour under the shapes can be distractive if not the right colour and composition is carefully investigated. When wearing black the undergarments connect to the black surface of the constricting yarn. Even though black is quite visible through the transparent material it could be an option to use it as the colour for undergarments. White would not work because it is too closely associated with underwear. Another successful example is the nude undergarments, they give a poetic expression to the garment.

The undergarments that are separated have a distractive line of skin between the top and the bottom, also the shoulder straps attracts unwanted focus. The shape of the body is more cohesive with the expression of the garments shape. Some kind of undergarment that covers the shoulder could be an option, something that is neither a singlet nor a t-shirt but corresponds with the shapes of the garment.

Layering of different garments was considered but later in the process it was found that one garment that was showing the interaction in each outfit was most clear.

During seminars the models have been wearing black fitted garments like jeans and a top under the knitted garments. This has been a successful way of showing the garments since black is a clear contrast to the colours used in the collection (fig.62). However some of the necklines has been interfering with the form of the garments, these undergarments are crossed in fig.62. Undergarments were made with a high neck as seen in fig.63 to not interfere with the knitted form of the main garments. The undergarments are black to enhance the colour and fitted to the body to clearly show how the form of the body and the form of the knitted garments relate to eachother. This is shown in fig.64 where the undergarments have been made for the collection.
Garment development
Dress
The garments are developed through several try-outs to find the right form, volume and colour setting. Here the development of the green and brown dress is shown as an example of how the working process has been performed in fig.65-71. The examples that were found interesting and developed further are circled.

Fig. 65. A toile is sewn and draped on the mannequin to find an interesting shape that show the interaction of the materials

Fig. 66. Here the positioning of the square is tried out, two different options were found interesting and were further developed

Fig. 67. Colour suggestions were made in photoshop and a decision was taken by looking at the colour composition in the whole collection

Fig. 68. The garment was knitted on the hand knitting machine in three separate pieces that was hand sewn together. The placement of the lycra square was tested again and alterations were made to create a desired volume

Fig. 69. After looking at the collection as a whole and how it had developed the decision of the placement of the lycra square was reevaluated

Fig. 70. It was considered to add a stripe, tests of colour for the stripe was performed but the decision was made that the stripe did not work in this garment

Fig. 71. Illustrating how the dress has developed in the lineup through the process
Development - pants

Here the development of the pants from an intarsia knitted piece to a ready garment. This is shown through a series of photos in fig.72-79.

**Fig. 72.** The first intarsia knitted sample, when draping this piece on the body it was found that the constricting part followed the body in an interesting way when the lycra was placed as the crotch

**Fig. 73.** A bigger piece was knitted in the same way but a coloured thread was added. The piece was draped on the mannequin in the same manner as in the photos above, the length of the attachment in the side seam was tested

**Fig. 74.** Black was added according to the concept and colour options were tested

**Fig. 75.** Alterations were made in the pattern to fit the measurements desired for the garment (the photos shown here is from the pattern for the coat, the pants pattern is similar)

**Fig. 76.** The first toile of the pants, the metal broke in one section (as circled) and some changes had to be made in the machine settings

**Fig. 77.** The pants were tested in a shorter silhouette where two threads of black yarn was used to make the garment more opaque but it was decided to go back to the first version of the pants

**Fig. 78.** Different garments and colour settings were tested with the pants, it was found that additional colour on the top of the garment took the attention away from the pants, for this reason it was decided to have a black top

**Fig. 79.** Illustrating how the outfit with the pants has developed in the lineup through the process
Lineup development

Here the development of the lineup is visualised, the development of the outfits in the final lineup can be followed through the colour coded lines in fig. 81-82.

The last lineup in fig. 82 is the lineup presented during the examination. Changes that have been made after the examination can be seen in the result chapter that starts on page 54.
Result

The result of this work shows a way of creating form in knitwear through material interaction and without the use of darts, shaped seams or partial knitting. The result is shown in a collection of seven examples. The examples are based from squares where the material interaction changes the form of the material and the garment.

The materials that were found to be most successful in creating form were the combination of lycra and stainless steel. For that reason this is the materials used in this work. In the examples the metal yarn is combined with cotton or polyester yarn in coloured sections or blocks to clearly show how the material interaction affect the shape of the garment.

In the collection the squares of lycra is placed on different parts of the body. It was found that the examples where only one placement of the constricting lycra was used was most clear.

All garments are knitted on an electronic flatbed knitting machine or a hand flatbed knitting machine. The garment pieces are knitted as flat pieces and are then sewn together. Sleeve openings are created in between knitted pieces where a section is left un-sewn.

In the description of the garments, illustrations show each garment as a square and how the colour is placed. The illustrations also show how the garment is created through colour coded lines where same colour lines are sewn together.

Materials

Lycra

Metal

Complementary

Jersey. Black polyester.
Singel jersey. Black polyester with glitter print.
Singel jersey. Black cotton/lycra.
Presentation of collection
Outfit 1

The dress is knitted on a flatbed hand knitting machine with 0.15 mm stainless steel thread and lycra. The garment is hand sewn with invisible stitches according to illustration and the edges are casted off.

The lycra square is placed on the side of the garment, on the hip. The colour blocks create lines that show the effect of the lycra. The placement on the side makes the effect visible from both the front and the back. This is the first outfit since it communicates the concept in a simple way.

Main materials

- **1x1rib. Polyamide/lycra 3 threads, Stainless steel 1 thread, grey cotton 1 thread.**
- **1x1rib. Stainless steel 1 thread, black polyester 1 thread.**
- **1x1rib. Stainless steel 1 thread, orange polyester 2 threads.**

Material complementary

- **Singel jersey. Black cotton/lycra.**
Outfit 2
The dress is knitted on a flatbed hand knitting machine with 0.15 mm stainless steel thread and lycra. The garment is hand sewn with invisible stitches according to illustration and the edges are casted off.

The lycra square is placed on the lower back of the garment, on the back of the knees. The placement of the lycra makes the model wearing the garment appear to have bent knees. The colour blocking and stripes highlight the form created from the material meeting.

Main materials

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1x1 rib.</td>
<td>Polyamide/lycra 3 threads, stainless steel 1 thread, olive cotton 1 thread.</td>
</tr>
<tr>
<td>1x1 rib.</td>
<td>Stainless steel 1 thread, brown cotton 3 threads.</td>
</tr>
<tr>
<td>1x1 rib.</td>
<td>Stainless steel 1 thread, black polyester 2 threads.</td>
</tr>
<tr>
<td>1x1 rib.</td>
<td>Stainless steel 1 thread, red polyester 1 thread.</td>
</tr>
</tbody>
</table>

Material complementary

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jersey.</td>
<td>Black polyester.</td>
</tr>
</tbody>
</table>
Outfit 3

The pants are knitted in an intarsia pattern on an electronic flatbed knitting machine with 0.12 mm stainless steel thread and lycra. The t-shirt is knitted on a flatbed hand knitting machine with 0.15 mm stainless steel thread and lycra. Both garments are hand sewn with invisible stitches according to illustration and the edges are casted off.

On the pants the lycra square is placed inside the legs as a crotch and the lycra make the garment bend in the shape of a pair of pants. Blocks of colour is used to highlight the effect of the lycra. The pants have hidden pockets in the side seam and are fastened with hook and eye in the waist.

The t-shirt has a lycra square placed on the front, the contraction of the lycra make the model wearing the garment appear to have a hunchback. The t-shirt has no colour blocking to not take attention from the pants. Instead the blocking is made with different transparency of the black to show the effect of the lycra.

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Main materials

1x1rib.
Polyamide/lycra 3 threads.
1x1rib.
Stainless steel 1 thread, black polyester 1 and 2 threads.
1x1rib.
Stainless steel 1 thread, brown cotton 1 thread.

Material complementary

Singel jersey.
Black polyester with glitter print.
Outfit 4

The dress is knitted on a flatbed hand knitting machine with 0,15 mm stainless steel thread and lycra. The garment is hand sewn with invisible stitches according to illustration and the edges are casted off.

The lycra square is placed on the top of the garment, on the shoulders. This placement does not bend the garment in any way but it show the difference in volume that is created by only changing the material, from the tightly fitted shoulders to the wide skirt. The colour blocks help to highlight the volume in the skirt.

Main materials

1x1rib.
Polyamide/lycra 3 threads. Stainless steel 1 thread, brown cotton 1 and 3 threads.

1x1rib.
Stainless steel 1 thread, brown cotton 1 and 3 threads.

1x1rib.
Stainless steel 1 thread, orange polyester 1 and 3 threads.

Material complementary

Singel jersey.
Black cotton/lycra.
Outfit 5
The kimono is knitted in an intarsia pattern on an electronic flatbed knitting machine with 0.12 mm stainless steel thread and lycra. The garment is hand sewn with invisible stitches according to illustration and the edges are casted off.

The lycra square is placed on the upper back of the garment. The placement pulls material together and creates volume for the sleeve. The colour blocks show how the garment is created.

Undergarment

Main materials

1x1rib. Polyamide/lycra 3 threads. Stainless steel 1 thread. Black polyester 2 threads.

1x1rib. Stainless steel 1 thread. Orange polyester 2 threads.

Jersey. Black polyester.

Material complementary
Outfit 6

The dress is knitted on a flatbed hand knitting machine with 0.15 mm stainless steel thread and lycra. The garment is hand sewn with invisible stitches according to illustration and the edges are casted off.

The lycra square is placed on the front of the garment, on the chest. The lycra makes the material pull towards the chest and the extra volume added on the back create a movement in the garment that is highlighted by the colour blocks.

Main materials

1x1rib. Polyamide/lycra 3 threads, 1 thread lurex.
1x1rib. Stainless steel 1 thread, brown cotton 1-3 threads.
1x1rib. Stainless steel 1 thread, black polyester 1-2 threads.
1x1rib. Stainless steel 1 thread, brown cotton 1-3 threads.

Material complementary

Singel jersey.
Black cotton/lycra.
Outfit 7
The jacket is knitted in an intarsia pattern on an electronic flatbed knitting machine with 0.12 mm stainless steel thread and lycra. The garment is hand sewn with invisible stitches according to illustration and the edges are casted off.

The lycra square is placed on the inside of the sleeves and makes the garment bend from the bodice to the sleeve. This garment is created in a similar manner as the pants only placed on another part of the body. The colour blocks highlight the shape created in the material interaction.

Main materials

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Fabric</th>
<th>Thread Composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1x1rib.</td>
<td>Polyamide/lycra</td>
<td>3 threads. Stainless steel 1 thread, brown cotton 1-3 threads.</td>
</tr>
<tr>
<td>1x1rib.</td>
<td>Stainless steel 1 thread, black polyester 1-2 threads.</td>
<td></td>
</tr>
<tr>
<td>1x1rib.</td>
<td>Stainless steel 1 thread, grey cotton 1 thread.</td>
<td></td>
</tr>
<tr>
<td>1x1rib.</td>
<td>Stainless steel 1 thread, blue cotton 1 thread.</td>
<td></td>
</tr>
</tbody>
</table>

Material complementary

Singel jersey.
Black polyester with glitter print.
Discussion & Reflection

This work explores the possibilities to use material interaction in knitwear as a way to create form on the body. The result is a collection of seven examples where the combination of metal and lycra yarn affect the shape of the material and the garment without the use of darts, shaped seams or partial knitting.

As stated in the motive chapter on page 2, material combinations are often seen in fashion as a decoration. The result of this work show a combination of material that clearly affect the shape of the garment. Even if the combination of the lycra square and the organic appearance of the metal can be seen as decorative, the purpose of the material combination is to create form. Without this combination of material the garments would only be long tubes.

The stripes or blocks of colour could also be seen as a decoration since they in themself does not affect the shape of the garment. However the blocks of colour does show how the lycra affects the metal in a clear way by visualising the curves created in the material interaction. To show the effect of the investigation only two colours would had to be used, one for the area connected with the lycra and one to show how the form is affected. Even so it has been important to work with several colours to get diversity in the expression and to put this work in a fashion context.

The transparency of the metal parts of the garment revealed the body and highlighted the volume that the interaction created. During the process it was found that the form created in the material interaction affected the appearance of the posture of the body. This was an unexpected but interesting result that could be interesting to explore further and look into how do distort the body even more. However in this work it has not been in focus to distort the body.

As stated before it was decided to develop the garments from the shape of a square. This decision was made to not be limited by the access of the electronic flatbed machine and thereby be more free in the experimentation of the form on the hand knitting machines. This machine is unable to knit intarsia pattern. Only full rows that extends over the whole needle bed is possible. This limitation has obviously affected the result of this degree work. This has kept the work and the result focused in one direction where the collection could have become scattered if this rule was not implemented. Koskinen (2011) writes that a basic relationship of variables is important in research and that theory or in some cases judgement can decide what should be ruled out.

This work explores a limited area of creating form through material interaction in the field of knitwear. The area can be explored further both when it comes to materials and form. In this work the constricting lycra is placed on different areas of the body. As a development the placement of the constricting part could be further explored, for example develop more ways to create sleeves and pants. The size and shape of the constricting part could also be developed further and by doing this a whole other expression could be found.

The degree work can be seen as an investigation that opens up for further exploration of the area. The method of this work could be commercialised and used to create three dimensional knitted garments. 3D knitted garments are starting to take ground in the sports industry to add different features to athletic garments. Choi and Powell (2005) writes that 3D knitted garment is predicted to be the largest knitting technique of the future. If so this way of creating form can be applied in the fashion industry to create other form possibilities in ready to wear knitted garments.
References


Figure references

Fig. 1. Illustration by author

Fig. 2. Illustration by author

Fig. 3. Versace, spring 2015. Adapted from: http://www.style.com/slideshows/fashion-shows/spring-2015-ready-to-wear/versace/collection/41
[Accessed May 11, 2015]

Fig. 4. Calvin Klein, fall 2014. Adapted from: http://www.style.com/slideshows/fashion-shows/fall-2014-ready-to-wear/calvin-kein-collection/collection/16
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Fig. 5. Edoardo Rossi. Adapted from: http://antwerp-fashion.tumblr.com/post/89380921837/edoardo-rossi-sunraiser
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Fig. 6. Helmut Lang, fall 2014. Adapted from: http://www.style.com/slideshows/fashion-shows/fall-2014-ready-to-wear/helmut-lang/collection/25
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Fig. 7. Uma Wang, spring 2012. Adapted from: http://chinafashioncollective.com/designer_ umawang3.htm
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Fig. 8. Helen Lawrence, fall 2015. Adapted from: http://www.helen-lawrence.co.uk/collections/ aw15-looks.html
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Fig. 9. Onda, Maris Balisse, 2000. Adapted from: http://www.mariabalisse.com/connie/projects/ Puginas/ondu.html#1
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Fig. 10. Craft, base layer. Adapted from: http://www.craft.se/sv/produkter.html?tx_mdb_p1%5B%5D=rix_mdb_p1%5B%5D=Craft&tx_mdb_p1%5B%5D=Warm
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Fig. 11-81. Author, degree work.
Appendix 1

Critique on John-Daniel Isakssons degree work

Idea: The idea of John-Daniel's work is to develop the camouflage print through quilting and filling. It is clear that the work merges camouflage print and quilting. However, I do not see this as a development of the camouflage print itself since this print is still similar to the original print in both shape and colour settings. The development is more in the creation of three dimensional form in quilting and filling with the help of the camouflage print.

Composition: The lineup contains both a more traditional colour scale in combination with a more innovative colours. I was sceptical towards the material in the 7th piece at first but then realized that it was showing all the other colours in the collection. Even so this material is quite alone in the lineup and as stated before John-Daniel's work could benefit from adding similar materials in other garments as well. In many garments the camouflage print have similar size, except in the 5th and 7th one where the scale is bigger. John-Daniel explains that the print disappeared when it was applied in bigger scale, however I think the work could benefit from having more diversity in scale.

Craftsmanship: John-Daniel clearly shows that he master the technique of quilting. In his research he shows an extensive exploration of materials conventional and un-conventional. The diversion of materials are missing in the result where only one outfit contains an un-conventional material. By adding more of this kind of material I think that John-Daniel could show of his great sense of materials in a better way.

These are the changes I made in John-Daniels work:

First of all I have removed all the knee high socks, they take to much attention and does not highlight the work. I read the socks as a sport reference but I do not think it is needed, the sport reference is clear without them.

Outfit 1 works well with the same print on the jacket and pants but I changed the top underneath to a black top since I think that the colour enhances the print.

Outfit 2-5 works well and no changes are made on these garments. I especially like outfit 4 and 5 where drawstrings are added as a clear reference to sportswear but they also give the garments a more three dimensional shape than during previous seminars.

Outfit 6 I made the skirt longer, in the collection most garments are in the same length and it could be nice to make this skirt longer to get a .

Outfit 7 first I thought I wanted to have this garment in a bigger scale, but when looking at it again I added a skirt underneath it. In this way the legs are not as naked and therfor the garment feels smaller. I also thought it would be good to bring back the kaki colour in this look to keep the collection together.

Original lineup

Reworked lineup