

THE USE OF COLOUR TO MANIPULATE PATTERN IN KNITTED FABRICS

FAIR ISLE PATTERN | COLOUR INSTABILITY | PATTERN PERCEPTION
FABRIC INNOVATION | ARTIST REFERENCE



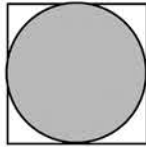
ABSTRACT

THIS PAPER WILL INVESTIGATE THE POTENTIAL OF UTILISING PREVIOUSLY DOCUMENTED ART AND DESIGN THEORY TO DEVELOP INNOVATIVE KNITTED FABRIC DESIGN. DESIGN HAS BEEN INFORMED BY SELECTED COLOUR THEORY AND BY THE PRACTICE OF BRIDGET RILEY.

Colour has a strong influence on pattern perception and can override Gestalt grouping factors (Pinna et. al. 2002). Itten noted the spatial effects of colour (Itten, 1961) which can be used to manipulate the figure/ground relationship.

The production of a series of knitted jacquard fabrics gave the opportunity to observe the interaction of colour in large discrete areas and blended colour. The use of traditional Fair Isle patterns allowed exploration of the figure/ground relationship. Emphasis of pattern was manipulated through colour to create un-expected movement, echoing the work of Riley.

Although based on artist reference and traditional techniques the investigation produced a methodology for the production of original and innovative fabric designs.



1
The effect on the perception of form of the compression of a circle.



2
Assimilation causes the blue to appear greener on the yellow background and more purple on the red background.

THE JUXTAPOSITION OF TWO COLOURS CAN CAUSE ONE COLOUR TO BE PERCEIVED AS BEING ON A CLOSER PLANE THAN THE SECOND COLOUR AND WILL AFFECT WHICH COLOUR IS SEEN AS DOMINANT.

1. INTRODUCTION

This paper will investigate the potential of utilising previously documented art and design theory to develop innovative knitted fabric designs. Fabric design has been informed by selected colour theory and by the practice of Bridget Riley.

Previous studies have shown that in traditional Fair Isle knitting patterns colour can be used to change the emphasis of the pattern (Gaston, 2006). In Fair Isle knitting complex geometric patterns are created from small and simple units of colour and rely on careful colour selection for aesthetic success. The close proximity of the constituent colours allows colour harmonies and/or contrasts (Gaston, 2006). This is congruent with the principles identified in the analysis of Bridget Riley's work which focus on the careful use of colour and the creation of visually complex images from the use of simple repeating units.

VISUAL ANALYSIS OF THE WORK OF BRIDGET RILEY

Bridget Riley's dynamic abstract paintings create perceptual movement and instability through subtle manipulation of colour and form. Formal structures are de-stabilised:

"dissolving into intense and unsettling perceptual experiences" (Moorhouse, 2003).

Through analysis of Riley's work a system was developed to apply to knitted fabrics in an attempt to recreate the ambiguity in her work.

MANIPULATION OF FORM

Early tonal works such as Loss (1964) manipulate a simple repeating unit both in form and tone. The gradual change in form, by reduction of one dimension, from a perfect circle to an oval creates the sensation of a curved form and receding plane over the whole image following the Gestalt law of Pragnanz. (See figure 1).

MANIPULATION OF TONE AND COLOUR

The reduction in tone of the circles in Loss from black to pale grey infers distance (Birren, 1961). The opposition of the two perceptual effects employed in this work causes the perception of ambiguous movement.

Deny (1966) introduced colour but the theme of the painting remains tone. An inversion of colour and tone in a series of ovals with subtle variation in orientation produces an opposition of structural movement and tonal movement. Where the tonal contrast is reduced there is greater colour contrast. As the tonal contrast increases the colour contrast is reduced (Kudielka, 1999).

As colour became more prominent in Riley's work, form was simplified. She stated that complexity of form and

complexity of colour were oppositional (Moorhouse, 2003). The relative effect of colours in combination is evident where the colours meet. The use of stripes allowed a long edge between adjacent colours which maximised the possibility of interaction of colour without volume of colour and complexity of form (Moorhouse, 2003).

Initially Riley used three colours in combination in her stripe paintings, two opposite colours and an adjacent colour. The relationship between the opposite colours was not perfect as this would harness the energy of the painting to two colours in complementary contrast (Moorhouse, 2003). Work was empirical, it was based on optical principles which were "deployed consciously or not" (Moorhouse, 2003). Colour bands which form across the paintings are not "literal colour" but emerge "through visual fusion" (Moorhouse, 2003). This is the effect of assimilation where close constituent colours take the hue of their neighbour (figure 2).

Riley has also used colour to create ambiguity of figure and ground. In *Rêve* (1999) the blue positioned with the yellow on the left of the painting advances the blue however when the same blue is positioned with green on the right of the painting the blue recedes. This emphasises the importance of context of colour.

Size of painting is important to the empirical methodology employed by Riley:

"In the same way that I had to sacrifice distinctiveness of forms in order to release the energy of colour-light, it was necessary to increase the scale of the event in order to prevent focused looking." (Riley in Kudielka, 1999).

Large scale pieces must be observed from a distance ensuring the whole

art work is seen rather than individual elements which would alter the perceptual energy of the piece.

PRINCIPLES EMPLOYED IN THE WORK OF BRIDGET RILEY

From the analysis of Riley's work a set of principles was identified which could be applied to knitted fabric in the creation of new patterning possibilities.

1. The gradual modification of tone throughout a painting.
2. The gradual modification of form throughout a painting.
3. The opposition of perceptual effects.
4. The opposition of tonal contrast with contrast of hue.
5. When three colours are used they should comprise of two opposite colours and an adjacent colour.
6. As colour complexity increases form should be simplified.
7. The edge between colour is important in the interaction of colour.
8. The use of effects such as assimilation and contrast can be employed.
9. Colour can be used to create figure/ground ambiguity.
10. The scale of work is important to the visual effect.

THE APPLICATION OF PRINCIPLE TO FABRIC

PROBLEMS IN KNITTED FABRICS

Not all of these principles translate well in to knitted fabric. In particular Riley's use of the crisp edge between adjacent visual forms is difficult to replicate in a knitted fabric. Conventionally yarns used in knitted fabrics have an inherent hairiness on the yarn surface. The knitted stitch appears on the face of the knitted fabric as a v shape. One knitted course, which would create the simplest arrangement of form, would

have the appearance of a horizontal line of v's.

Pigment can be blended in an infinite number of proportions to create a visually smooth transition from one colour to another or to create a tonal scale. The surface of a knitted fabric is created from the discrete units of the knitted stitch allowing only the possibility for discrete units of colour.

FAIR ISLE PATTERNS

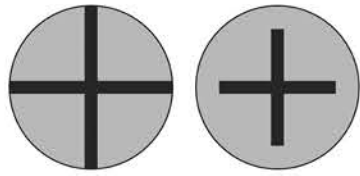
The course and wale structure of knitted fabrics produces a grid into which jacquard pattern can be applied. This encourages the use of the vertical, horizontal and diagonal geometric patterns seen in Fair Isle designs (McGregor, 1981).

Fair Isle patterns are built up from a series of small elements. Despite the overall size of pattern used, technical considerations restrict the size of individual pattern elements so that although the overall pattern size may be altered the size relationship between the individual blocks of colour will not change and the relationship between colour fields remains the same.

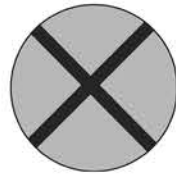
Traditional use of two-colour stranded knitting uses only two colours in each course. When a pattern area with two colour fields is viewed, one colour field assumes the role of "figure" and one colour field assumes the role of "ground". Well documented rules govern the relationship between figure and ground and these rules can be manipulated to confuse the relationship.

PATTERN PERCEPTION OF FIGURE AND GROUND

Gestalt principles of pattern perception states that the relative size, surround, orientation and symmetry of one area will affect the viewer's perception of the area as either figure or ground (Bruce et al, 2003).



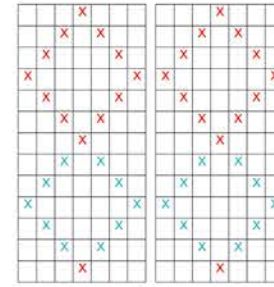
3
The relationship of area in figure and ground patterns.



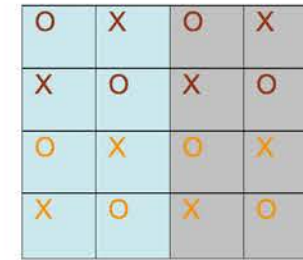
4
The importance of orientation in figure and ground patterns.



5
The effect of good continuation results in the perception of an X rather than two V shapes.



6
The effect of colour on the figure/ground relationship.



7
The colour relationships in fabric four.

The smaller of two areas is perceived as a figure. The effect is emphasised if the small area is surrounded by the larger area. (See figure 3).

The orientation of the “figure” colour field can affect the perception of the pattern. A horizontal or vertical direction (+) emphasises the field as figure however a diagonal orientation of a cross (X) can reduce the “figure” effect and the larger spaces between the cross which now have a vertical and horizontal axis can now assume dominance (Rock, 1973). The ambiguity caused by the reduced figural effect of a X can be manipulated in Fair Isle fabrics. (See figure 4).

The Gestalt principle of Good Continuation is also important in the perception of figure and ground in Fair Isle patterns. This states that a smooth line is preferable to one with abrupt changes. Two intersecting lines are perceived as a cross rather than two v's. (Bruce et al, 2003). (See figure 5).

In the repeating all over pattern of a Fair Isle design this will influence the perception of which colour field is dominant.

THE SPATIAL EFFECTS OF COLOUR

The juxtaposition of two colours can cause one colour to be perceived as being on a closer plane than the second colour and will affect

which colour is seen as dominant. Dominance of colour has been shown to over ride the Gestalt grouping factors allowing the possibility to manipulate the figure or the ground through colour selection (Pinna et al, 2001). (See figure 6).

A small area of colour is seen to advance over a large background. This emphasises the figure/ground relationship in which the smaller area is perceived as the figure.

The figure/ground relationship is emphasised by contrast of value. Light colours advance and assume dominance on a dark background, conversely dark colours advance and assume dominance on a light background (Itten, 1961). Hues of similar value lack contrast when seen in isolated fields of a pattern/ground relationship. In a previous study of the figure ground relationship in Fair Isle patterns in most cases the dominant colour was the lightest (Gaston 2006).

Saturated colours are perceived to dominate and advance on tints, shades and tones of de-saturated colour. Warm colours generally appear in front of cool colours of similar saturation and value (Birren 1987).

FABRIC SPECIFICATIONS

A collection of knitted fabrics was produced applying previously documented colour pattern perception

theories and employing principles employed by Bridget Riley. The aim was to produce aesthetically pleasing fabrics with strong visual interest

The fabrics were hand knitted on 8mm needles using a commercial range 100% wool of an approximate resultant count of 1Nm. The colour was selected from the commercial range “Freedom” spun by Twilleys of Stamford.

A repeating pattern was produced from three elements. Although the three patterns are different in overall size they are all constructed from smaller elements no more than 5 stitches in width at any point. This results in the relationship between the colour fields of figure and ground remains the same scale in all three patterns.

FABRIC ONE

Fabric one experimented with the opposition of graduated value and graduated hue. It employed the three different sized elements

The pattern graduated in hue vertically from blue to red in colour wheel order, tints and tones of colour were employed. The colours used were of similar value with the exception of the palest pink. This created a graduating scale of adjacent colours.

An orange based neutral was used for the ground in opposition to the blue of the pattern. There was limited

graduation of value vertically, however in selected areas the ground graduated in value horizontally across the width of the fabric.

FABRIC TWO

Form was simplified in fabric two by the use of a mid-sized pattern which experimented with the transition from one colour field to the next colour field horizontally to reduce the effect of discrete colour blocks. At the border between two colour fields of the ground an area of 1 x 1 bird's eye was knitted in an attempt to blend the two colours optically through assimilation. A dark blue-grey and a dark green-grey were selected.

Fabric two also experimented with the inversion of value and hue. The pattern was repeated three times. In each version the pattern was knitted in a solid colour. Version one was knitted in a light green emphasising contrast of value but minimising contrast of hue. Version two was knitted in a strong red, reducing the contrast of value but increasing the contrast of hue. Version three was knitted in a de-saturated red-brown reducing both the contrast of value and the contrast of hue.

FABRIC THREE

Fabric three experimented with the inversion of pattern and ground.

One colour field was created from a solid green; the opposing colour field was created from a vertical tonal scale

of three reds. The design was split in a ratio of 3:4 across the width of the pattern. In the larger area the ground was green and the pattern was created from the triad of reds. In the smaller area the colour was inverted resulting in the pattern being knitted in solid green and the ground created from the triad of reds.

FABRIC FOUR

Fabric four experimented with the inversion of pattern and ground and with tonal graduation in the same piece. Colour opposites of blue and orange were used.

A simple pattern was repeated to form an all over design which was divided into four quadrants with graduation from blue to blue-grey horizontally and graduation from orange to orange-brown vertically. A diamond shaped area in the centre of the design was selected to demonstrate inversion of figure and ground. (See figure 7)

ANALYSIS

The success of the fabrics produced was determined by whether they were aesthetically pleasing and whether they created visual interest following the design principles employed.

FABRIC ONE

(See figure 8). The most successful area of the design was the graduated value scale across the width of the fabric. This did however form four

vertical stripes of colour area. The most successful border was that between the mid-dark and dark areas of the background which were knitted in melange yarns and were closest in value.

Although the graduation of change in hue from blue to red was successful remotely from the knitted piece, within the given Fair Isle pattern the lack of variation in value in the hue scale resulted in a lack of visual interest in the finished piece demonstrating the importance of contrast of value throughout a final design following Riley's principle of opposition of tonal contrast with contrast of hue. The principle that as colour complexity increases form should be simplified has not been followed here which results in a loss of definition of form.

FABRIC TWO

The simplified form of the pattern ensured that the complexity of colour could be observed.

The 1 x 1 bird's eye pattern knitted at the border of the two background colour fields was successful in blending the transition between the two where no additional pattern was employed. It produced a third colour field mid way between the two solid fields. The technique was less successful when a pattern was applied over the bird's eye area. The diagonal pattern of the X coincided with and



8
Fabric one

10
Fabric three

11
Fabric three, detail

12
Fabric four with inverted
colour area bordered in grey

masked the diagonal positioning of one colour in the bird's eye pattern causing a secondary pattern to appear. (See figure 9).

The inversion of value and hue performed as expected. Version one which emphasised contrast of value but minimised contrast of hue and version two which reduced the contrast of value but increased the contrast of hue both produced clear figure/ground separation. Version three which reduced both the contrast of value and the contrast of hue produced a figure/ground relationship that lacked clarity.

FABRIC THREE

The OXO pattern in fabric two clearly formed the figure, following Gestalt principles of a small area surrounded by a larger area being perceived as a figure. In fabric three where the pattern is produced from analogous reds and the ground is solid green the same pattern reacts differently. The area surrounding the spot of the small pattern (A) assumes the characteristics of the figure with the extremities of the X

and the diagonal peerie pattern knitted in bright red and orange respectively unite visually to form a surround following the Gestalt principle of good continuation. The new figure is oriented vertically which is more prominent perceptually than the diagonals of the X. The centre of the X, knitted in dark red (B), has less contrast with the ground and is less dominant. (See figure 10).

The unexpected form is replicated in the inverted area of the pattern, where the triad of reds forms the ground to the design. The ground area surrounding the small spot forms a distinct, truncated diamond. The clear saturated red and the lighter orange advance visually on the darker and less saturated green. (See figure 1).

When elements of the overall pattern are seen in isolation they react as expected with the OXO pattern being identified as the figure. This agrees with the principle that the size of the pattern area and viewing distance are important.

FABRIC FOUR

Fabric four experimented with the inversion of pattern and ground and with tonal graduation in the same piece. The intended effect of ambiguous figure and ground, observed in fabric three, is not replicated in fabric four. The overall fabric size is not large enough to demonstrate the intended effect despite the simplified OXO pattern. At the point of colour inversion the form becomes distorted and the central area of inverted colour is confused by complexity of colour and form in a small pattern area. (See figure 12).

CONCLUSION

Following the aims of the study to produce aesthetically pleasing fabrics with visual interest the most successful fabric was fabric three. Whilst following identified colour theory it created visual dynamism and figural ambiguity.

Analysis of the four fabrics has led to the modification previously stated principles.

- 1 The gradual modification of tone

throughout a fabric.

- 2 In the opposition of contrast of value with contrast of hue it is important to retain some graduation of value within the hue to maintain visual interest.
- 3 In the opposition of contrast of value with contrast of hue, as contrast of value increases contrast of hue decreases and vice versa.
- 4 When three colours are used they should comprise of two opposite colours and an adjacent colour.
- 5 As colour complexity increases form should be simplified.
- 6 The use of effects such as assimilation and contrast can be employed.
- 7 Colour can be used to create figure/ground ambiguity.
- 8 The size of work and viewing distance is important to the visual effect.

The refined set of principles, still reflecting the work of Bridget Riley but more suitable for knitted fabrics, can be employed to produce large scale pieces demonstrating visual dynamism.

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9 Fabric two