Evaluation of Colour Effects on Knitted Fabrics using Marl Yarns

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ABSTRACT

Marl yarn, consists of combining two or more coloured yarns, has been commonly used by knit designers for creating innovative knitwear over decades. It is observed that different types of yarn parameters and knitting techniques can lead to a variety of colour effects (or, often, referred to as marl effects). However, there is relatively little literature discussing the formation of such marl effects in details. Therefore, exploring and unifying standard of marl effects is valuable as it could help knit designers to present their ideas faithfully and the fashion industry to diversify knitted fashion for the growing needs in the market. This study is aimed to investigate the relationship of yarn parameters and knitting techniques with marl effects. Four factors – yarn colours, yarn type, knitting machine gauge, and knitting structure – have been considered. In a psychophysical experiment, a set of 36 knitted samples were assessed according to the degree of marl effect. The results allow a better understanding on how to prepare knited fabrics to achieve different degrees of marl effect. This understanding would particularly be useful for knit designers to achieve their predetermined requirements and could also contribute towards quality control.

1. INTRODUCTION

Marl yarn has been commonly used by knit designers for creating innovative knitwear over decades. Textile Terms and Definitions defined marl yarn as a group of yarns that containing two or more different coloured single ends twisted together (Textile Institute 2002). The appearance of a knitted fabric composed of marl yarn using different types of yarn, knitting parameters and knitting techniques can lead to a variety of colour effects (or more often referred to as marl effects). Whilst knit designers often have predetermined requirements for a given marl effect in order to meet their knitwear design needs for the market sectors, there is relatively little literature discussing the formation of such marl effects in details. Figure 1 shows examples of knitted fabrics with different degrees of marl effects. It is suggested that high degree of marl effect corresponds to two (or more) colours of a textile sample being evenly distributed in a dotted manner.

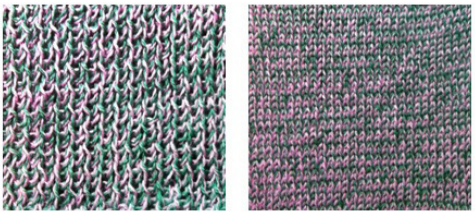


Figure 1: Examples of knitted fabrics with different degrees of marl effects.

This study is aimed to investigate the marl effects of knitted samples produced by different knitting parameters. This would allow better understanding for knit designers to achieve

their predetermined requirements. In addition, this could contribute towards quality control in which predictable visual results of marl effect can be applied to manufacturing and supply chain to providing a situation of predictable outputs (Romano and Vinelli 2001).

2. METHOD

2.1 Sample Preparation

Table 1 listed the four yarn and knitting parameters that were considered in the study: (a) yarn type, (b) yarn colour, (c) knitting machine gauge size and, (d) knitting structure. The yarns are all with the same count and have been twisted under the same condition of 100 turns per metre and in Z direction. The spectral reflectance factors were measured for each of the eight yarns at 10nm intervals in the visible spectrum to allow the calculation of CIE tristimulus values. In total 12 pairs of two-colour marl yarns were prepared and a set of 36 samples (6 colour pairs ´ 3 gauge sizes ´ 2 knitting structures) was knitted by combining different parameters systematically.

Table 1. Various yarn and knitting parameters.

Yarn type	Worsted, acrylic
Yarn colour	Worsted: light blue, blue, purple, ivory Acrylic: ice green, dark blue, brown, ginger
knitting machine gauge size	5, 7, 10
knitting structure	Single jersey, 1 × 1 rib

2.2 Psychophysical Experiment

The samples were cropped to a size of 9 × 9 cm and mounted onto black card. A ranking method was proposed for the visual assessment. The experiment was carried out in a darkened room and the samples were presented in a viewing cabinet illuminated by a light source approximating the D65 illuminant. Ten observers with normal (or corrected-to-normal) visual acuity and normal colour vision participated in the experiment. The experiment conisisted of two stages. In the first stage, 6 groups each containing 6 samples in turn were viewed by observers. The observers were asked to rank the samples in order of their degree of marl effect (i.e. two colours of a textile sample are evenly distributed in a dotted manner). The rank orders were converted to interval-scale Z values using Torgerson's Categorical Scaling method (Bartleson 1984; Torgerson 1962). In the second stage, 6 samples each with the highest degree of marl effect, according to the Z value, within its group were ranked by the same group of observers. The rank orders were converted to interval-scale Z values in the same manner.

3. RESULTS AND DISCUSSION

Figure 2 shows an example of a set of 6 samples in the order of their degree of marl effect obtained in the first stage of example. Table 2 summarises the final results obtained from the visual assessment. It shows the yarn and knitting parameters of the 6 samples that are deemed to be of highest degree of marl effect.

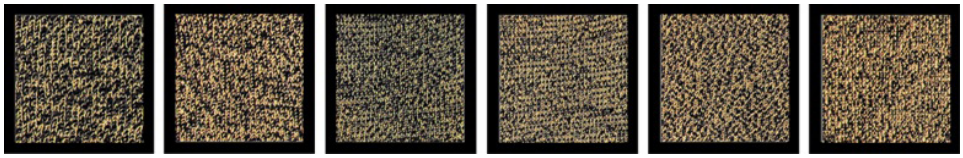
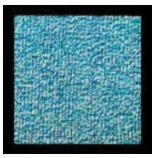
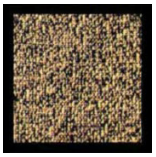
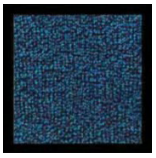
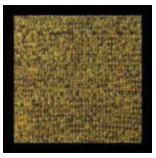
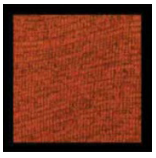
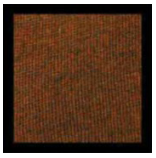


Figure 2: A set of 6 samples in the order of degree of marl effect (left to right: lowest to highest) obtained in the first stage of experiment.

Table 2. Yarn and knitting parameters of the 6 samples with highest degree of marl effect.

		Yarn parameters		Knitting parameters	
ranking order (degree of marl effect)	sample	colours	type	gauge size	structure
1		light blue × blue	acrylic	10	1 × 1 rib
2		ivory × purple	acrylic	10	1 × 1 rib
3		blue × purple	acrylic	7	1 × 1 rib
4		ice green × dark blue	worsted	7	single jersey
5		ginger × brown	worsted	10	single jersey
6		brown × dark blue	worsted	10	single jersey

The results indicate that fabrics produced by a larger gauge knitting machine (size 7 or 10) tend to have a higher degree of marl effect. It is noted that the smoothness of acrylic yarns allows stronger marl effect whereas the hairiness of worsted yarn inhibits the effect. The impact of knitting structure seems to be insignificant. Table 3 shows the CIELAB colour differences of the two yarns for each of the 6 samples. In general, samples comprise of two yarns with large colour difference are deemed to have stronger marl effect. Table 3 also shows the corresponding CIELAB lightness and chroma differences. It is evident that lightness difference has made a bigger contribution to the marl effect compared with chroma difference.

Table 3. CIELAB lightness (L), chroma (C_{ab}*) and colour differences.*

ranking	colours	ΔE_{ab}	ΔL^*	ΔC_{ab}^*
1	light blue ´ blue	35.23	32.91	-12.34
2	ivory ´ purple	77.17	65.90	-8.86
3	blue ´ purple	32.92	22.23	5.71
4	ice green ´ dark blue	23.37	19.76	2.14
5	ginger ´ brown	18.99	14.51	11.88
6	brown ´ dark blue	20.24	-2.90	8.65

5. CONCLUSIONS

This study illustrates that the degree of marl effect of knitted fabrics is driven by the yarn and knitting parameters. The results show that yarn type, yarn colour (difference) and the size of knitting machine gauge enable a more significant contribution on marl effect. The findings of this study allow a better understanding on how to prepare the knitted fabrics to achieve different degree of marl effect. These can help knit designers to effectively produce knitwear according to their predetermined requirements and provide better quality control with the scope of the samples used for this study.

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