THE EFFECTS OF COLOUR IN HUMAN FABRIC PERCEPTIONS

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ABSTRACT

The impact of colour on human perceptions of different fabrics is a topic of great interest to researchers, designers, manufacturers, and customers alike. To shed light on this important issue, this study investigated the relationship between coloured-fabric and human perceptions of different fabrics. A total of sixty coloured-fabric samples were carefully selected from twenty distinct colours and three materials, namely cotton, linen, and silk. An experiment was conducted using the psychophysical method, with eighty participants (forty males and forty females) evaluating sixty fabric samples in random order under simulated D65 illumination. Participants rated eight perceptions, including Temperature, Thickness, Gender, Activity, Pleasure, Arousal, Interest, and Preferences, using the 7-point-Likert scale method.

The coloured-fabric samples were plotted in the CIELAB space, and the results revealed that the human fabric perceptions were significantly affected by fabric colour across all three materials, albeit at varying levels. The degree of L* was found to have a significant impact on all eight human fabric perceptions, particularly Silk-Arousal, which had a correlation coefficient of 0.89. Both degrees of a* and b* also influenced some of the fabric perceptions, but the effect varied depending on the material type. For instance, the a* value exhibited a more pronounced effect in femininity of linen (0.50) as opposed to cotton (0.46), and in the realm of fabric pleasure, the b* value exhibited a more pronounced in cotton (0.55) compared to silk (0.47). Overall, this study highlights the complex interplay between fabric colour and human perception and underscores the importance of considering fabric colour in the design and manufacturing of textiles. The findings may have practical implications for designers, manufacturers, and retailers in terms of developing products that meet consumers' needs and preferences. This study may also serve as a foundation for future research on fabric perception, which could help to expand our understanding of the ways in which fabric colour affects human perception.

Keywords: Coloured Fabric, Visual Perception, Tactile Perception, Fashion Design.

INTRODUCTION

Fashion design entails a multifaceted process that seamlessly integrates various elements, including fabric material, texture, and colour, to craft garments that are both visually appealing and functionally effective. Designers carefully select materials that align with their artistic vision and intended message for the garment (Kawamura, 2005). This selection process considers attributes such as durability, drapability, texture, and suitability for the desired design. Fabric material significantly impacts the sensory experience of wearing a garment. Designers take into account factors like comfort, tactile sensations, and thermoregulation when making material choices. For example, cotton is favoured for its breathability and softness, while silk is known for its luxurious texture and visual sheen (Veblen, 2003). Linen offers a distinct tactile experience and relaxed aesthetic (Ryan, 2012). The chosen material can greatly enhance or inhibit the overall sensory and functional aspects of the garment. On the other hands, colour serves a pivotal role in fabric design, evoking emotions, conveying cultural symbolism, and influencing visual perceptions. Colour psychology contributes to the perception of clothing, as different colours

evoke various emotional responses and messages. Warm colours like red may evoke excitement and passion, while cooler tones like blue might suggest calmness and professionalism (Ou & Luo, 2014). Designers skilfully leverage these psychological effects to elicit specific emotional reactions and elevate the visual impact of their designs. Moreover, sustainability considerations have spurred a shift in material selection. Designers now explore eco-friendly alternatives like organic cotton and recycled fabrics (Fletcher, 2012). These choices not only align with sensory preferences but also contribute to broader environmental and ethical concerns.

Currently, research investigating the combined effects of fabric material and colour on human sensory perception in clothing design is in its nascent stages. The fabric material chosen significantly influences the sensory encounter of wearing a garment, encompassing aspects of comfort, texture, and aesthetics. Additionally, the colour integrated into the fabric contributes to visual stimuli, potentially shaping human perception in diverse ways. Further exploration is required to comprehensively grasp the intricate interplay between fabric material, colour, and sensory perception in the realm of clothing design.

For this study, human perception scales have been used to investigate the effect of colour for fabric appearance. The research aims have been classified as 1) to explore whether colour will influence human perceptions in the same material; and 2) to explore how the relation between colour values influence the perceptions.

EXPERIMENTAL DESIGN AND METHOD

The main purpose is to explore the effect of colour in human fabric perception in fashion design. Thus, twenty target colours were selected from popular colours for spring/summer clothing in 2022 (colour name and information please see TABLE I); and three different martials were selected to determine human fabric proception.

Table 1: Colour information.

Colour	L*	a*	b*	C*	h	ΔE
Dark red	25.84	32.57	17.82	37.30	28.28	5.02
Red	36.61	55.75	22.74	60.21	22.20	2.72
Light red	68.15	17.62	3.78	18.03	12.26	2.87
White	80.85	0.32	0.34	0.55	46.49	2.60
Beige	77.00	1.24	7.39	7.50	80.35	3.19
Black	10.90	0.04	-0.92	1.39	277.69	2.68
Light gray	71.63	0.22	-0.44	0.58	248.29	3.50
Light blue	70.16	-3.86	-7.76	8.70	244.67	3.52
Blue	39.91	-4.38	-16.61	17.32	255.21	3.23
Dark blue	19.56	1.09	-10.49	10.54	275.92	1.27
Green	68.87	-12.00	30.99	33.24	111.12	3.75
Dark green	39.12	-40.87	21.91	46.38	151.81	3.69
Cyan	76.92	-7.15	-0.16	7.17	181.19	1.63
Light purple	70.32	6.42	-6.44	9.11	314.92	3.13
Purple	59.86	13.99	-12.56	18.85	318.52	3.91
Brown	47.21	9.66	16.85	19.44	60.31	2.67
Light brown	68.20	6.00	14.30	15.53	67.51	2.25
Light yellow	75.90	-5.60	33.49	33.96	99.60	7.97
Yellow	68.58	8.42	55.91	56.60	81.62	4.98
Orange	64.93	21.71	32.00	38.68	55.94	4.88

In this study, 60 coloured fabric samples were selected. Each of the samples was defined as CIE L*a*b* and CIE L*C*h values which were measured using a VeriVide DigiEye System in the D65 lighting condition (Li and Zhu, 2012). TABLE III reports the actual measured colours from all samples, and also show the average ΔE between same colour with different materials.

Furthermore, variability in colour appearance in likely to be significantly smaller than variability in colorimetric measurements. This visual-matching process introduced a small amount of error; however, observers would recognise the fabric samples as being categorically either red, yellow, or green etc. (Yu et al., 2023).

In this study, one psychophysical experiment was conducted to investigate the human perceptions for single coloured-fabric. Eight bipolar perception scales were used in this experiment: warm-cool, thick-thin, masculine-feminine, calm-active, displeasure-pleasure, tense-relax, boring-funny and dislike-like (Ou et al., 2004). The experiment was situated in the dark psychology experiment room. Each participant assessed sixty 20*20 cm coloured-fabric samples one by one with a random order in a uniform grey with L*of 50 was used as the background inside the cabinet, with a 60 cm distance from participants' eyes to the samples. In the experiment, participants were asked to see and touch the coloured fabric samples for 30 seconds, then evaluated the eight perception scales (in a random order) in 7-point Likert scale as a question "Which word is more closely associated with the coloured fabric presented—warm or cool?"

In this study, a total of 80 participants were recruited to take part (comprising of 40 males and females, between the age 18-35 years old), all participants were students or staff at the University. All observers had colour science training before the experiment was conducted.

RESULTS

The comparative data is converted to interval-data *z* scores (Yu et al., 2023). The findings elucidate a uniform perceptual inclination among the participants towards the assorted materials under investigation. Noteworthy is the robust resonance elicited by silk materials across all eight dimensions of perception. In stark contrast, linen materials exhibit a marked attenuation in perceptual responsiveness, particularly evident within the realms of thickness-thinness, warmth-coolness, and masculinity-femininity scales. Please see FIGURE 1.

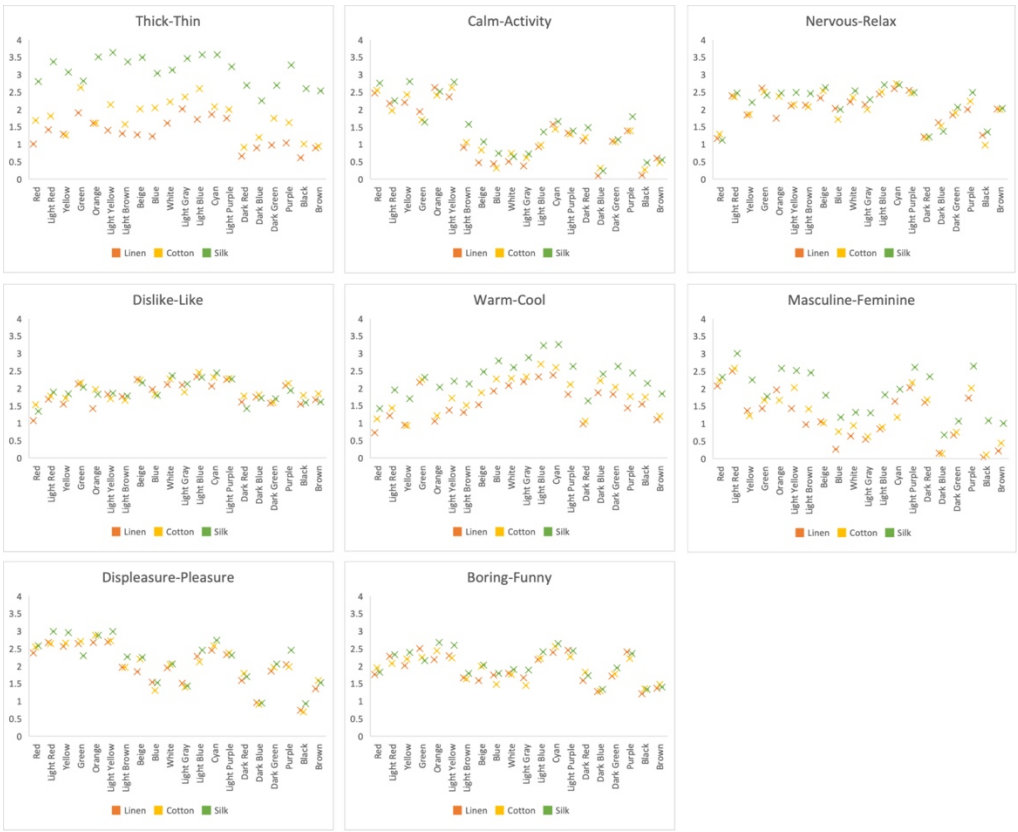

Figure 1. Example of figure

On the other hand, the outcomes of human perception regarding diverse fabric colours and materials are depicted in FIGURE 1. Notably, Orange, Green, and Light-Yellow exhibit heightened engagement, for example in calm-activity and boring-funny scales, while Light Red evokes a pronounced sense of femininity across all materials. In terms of fabric preference, Light Blue garners prominence in cotton and linen. Cyan manifests multifaceted attributes, for instance, it assumes a cooling disposition in linen and silk, and a demeanour of relaxation and levity in cotton applications.

Paired t-tests were executed to assess perceptual disparities across colours within cotton, linen, and silk. Among 24 tests, all materials exhibited notable variations in eight dimensions. Notably, thickness-thinness, warmth-coolness, and masculinity-femininity displayed substantial distinctions. Over 70% of comparisons indicated significant fabric perception differences across materials ($p < 0.05$). Noteworthy occurrences include 50% significant divergence between linen-cotton, 87.5% between linen-silk, and 87.5% between cotton-silk. Silk materials notably exhibited a comparable perception to both cotton and linen. The results also underscore the intriguing observation that silk materials displayed perceptual tendencies that were largely analogous to those of both cotton and linen. This brings attention to the complexity of fabric perception and its interplay with material attributes.

Table 2: Paired T-Test for eight motion scales in three materials for the same colour.

Motion Scales	Paired Samples Test	Sig. (2-tailed)
Thick-Thin	Linen - Cotton	**0.000***
	Linen - Silk	**0.000***
	Cotton - Silk	**0.000***
Calm-Activity	Linen - Cotton	0.263
	Linen - Silk	**0.000***
	Cotton - Silk	**0.000***
Nervous-Relax	Linen - Cotton	0.571
	Linen - Silk	**0.006***
	Cotton - Silk	**0.002***
Dislike-Like	Linen - Cotton	**0.026***
	Linen - Silk	0.122
	Cotton - Silk	0.359
Warm-Cool	Linen - Cotton	**0.000***
	Linen - Silk	**0.000***
	Cotton - Silk	**0.000***
Masculine-Feminine	Linen - Cotton	**0.048***
	Linen - Silk	**0.000***
	Cotton - Silk	**0.000***
Unpleasure-Pleasure	Linen - Cotton	0.154
	Linen - Silk	**0.001***
	Cotton - Silk	**0.024***
Boring-Funny	Linen - Cotton	0.686
	Linen - Silk	**0.003***
	Cotton - Silk	**0.002***

The fabric samples, differentiated by colour, were mapped within the CIELAB colour space. The resultant findings underscore the considerable influence of fabric colour on human perceptions across the spectrum of three distinct materials, albeit to varying extents. Notably, the L* component exerted a statistically significant impact on all eight facets of human fabric perception. Particularly noteworthy is the robust correlation coefficient of 0.89 observed between the L* value and Silk-Arousal perception. Both the a* and b* components also yielded discernible effects on select fabric perceptions, with the magnitude of influence contingent upon the specific material under scrutiny. For instance, the a* value exhibited a more pronounced effect in femininity of linen (correlation coefficient of 0.50) as opposed to cotton (correlation coefficient

of 0.46). Likewise, in the realm of fabric pleasure, the b* value exhibited a more pronounced in cotton (correlation coefficient of 0.55) compared to silk (correlation coefficient of 0.47). This multifaceted relationship between fabric attributes and human perception highlights the intricate interplay of colour, material, and perceptual responses.

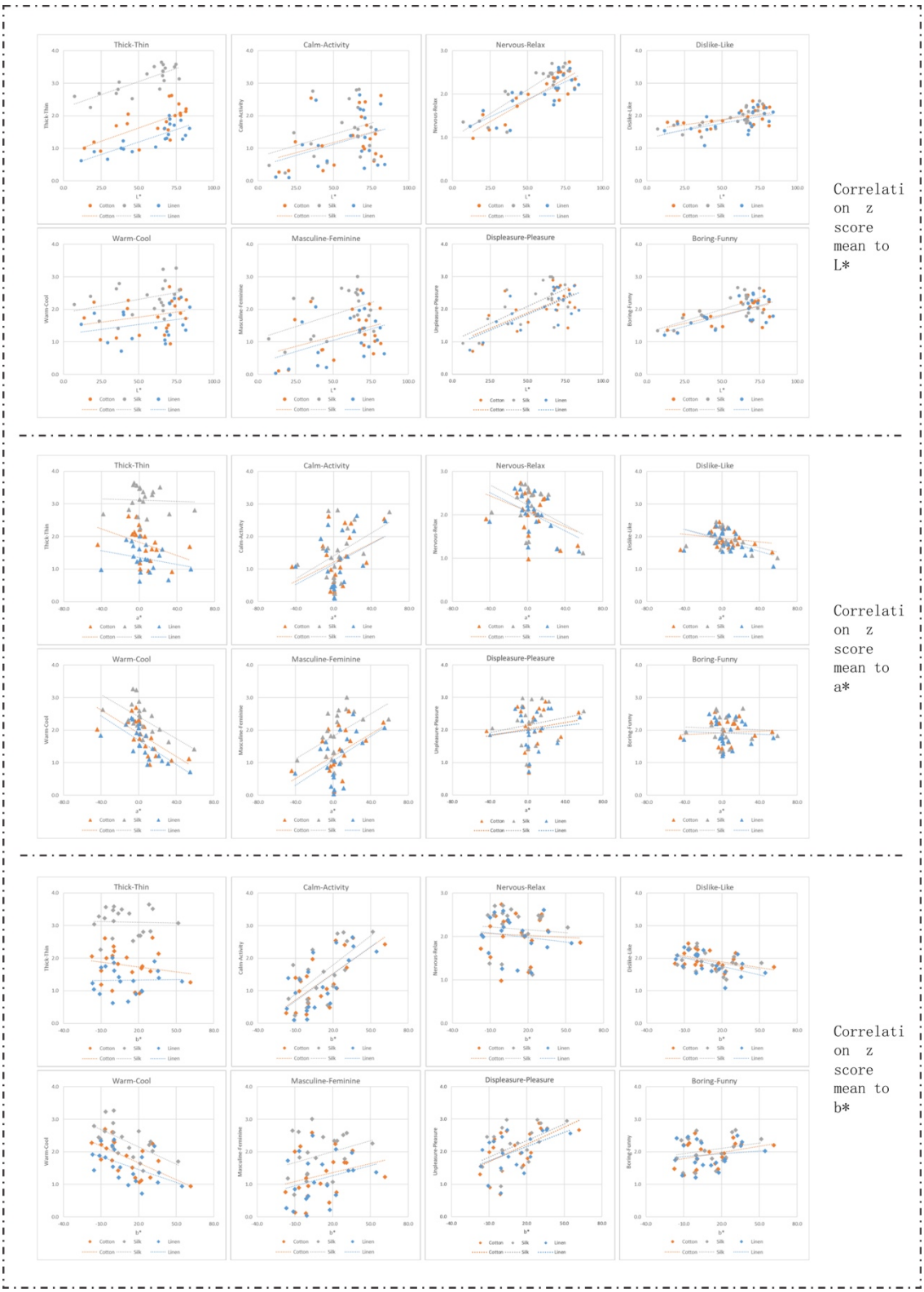

Figure 2. The correlation between motion scales in CIELAB space.

CONCLUSION

Overall, this study highlights the complex interplay between fabric colour and human perception and underscores the importance of considering fabric colour in the design and manufacturing of textiles. The findings may have practical implications for designers, manufacturers, and retailers in terms of developing products that meet consumers' needs and preferences. In the future work, this study may also serve as a foundation for future research on fabric perception, which could help to expand our understanding of the ways in which fabric colour affects human perception.

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