Discussion on Fashion Color Forecasting Researches for Textile and Fashion Industries

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Abstract: Overview of researches on fashion color forecasting. Concern the important contributions and achievements on fashion color forecasting researches. Divide the current researches into two main types: systematic analysis system and historical color data analysis in terms of the objectivities. Propose the common methodologies applied in the researches: personal color preference investigation (systematic analysis), rough set, grey theory, statistical analysis etc. Discuss the deficiencies, including data collection and prediction model problems that existed in the current forecasting researches.

Keywords: Color forecasting, color palettes, color preference, grey theory, forecasting accuracy.

1. Introduction

Color forecasting is considered as one of the significant driving forces for the fashion and textile industries, however little information exist about its methodology and even lesser in-depth information is currently available about this complex and intuitive process. Scholars and research teams attempt to demystify and clarify the process of fashion color forecasting and then forecast the colors accurately, that consumers will purchase in the near future approximately two years ahead. This article made a review on current fashion color forecasting researches. The forecasting models were introduced and discussed, which probably can provide the costumers and researchers some valuable references in this aspect.

In this paper, researches were classified into two main types in terms of the methodologies and analysis objectivities. They are systematic methodology and historical data analysis methodology. Each type's purpose and detailed information are demonstrated as following:

(1) Systematic methodology-namely subjective or qualitative analysis method is a typical method, widely used by authoritative color forecasting associations or agencies, such as *International Commission for Color in Fashion and Textiles* (IC), *International Color Authority* and so on. In this method, a forecasting model is required and the analysis items are complicated, involving all the connected factors like vogue, social life style, global economy, customers' color preferences, military affairs and so on. The decision on the future fashion color is mostly dependent on color experts and forecastors' intuitions.

(2) Historical data analysis methodology-namely quantitative methodology, aims to investigate potential changing rules existing in fashion color trends. This method was originally put forward by *Japan Fashion Color Association* (FAFCA). This method emphasized on the past fashion color trends data analysis combined with market's statistic survey.

2. First Contributions to Color Forecasting

Color forecasting is the significant product of the latter half of the twentieth century. In written sources, Harold Linton, professor, chairman of the department of art and visual technology at GMU (George Mason Universtiy), firstly contributed to the systematic demonstration of color forecasting and its application. In his book: *Color Forecasting: A Survey of International Color Marketing* (1994) [1], the forecasting way, the mystery and technology of color forecasting were described, which undo the puzzles that troubled the customers and the businessmen for a long time. These documents played considerably important roles in latter researches.

Then, Dr. Tracy Diane Cassidy (TD McLuckie), freelance designer and color consultant, lecturer of manchester metropolitan university, carried on such

task. In her book: *Color Forecasting* (2005) much information was conveyed, such as when color forecasting began and how it was developed. Color terminology and some of the more subjective tools used by color forecasters were explained. The strengths and weaknesses of the current forecast model were compared [2]. In her follow up work: *Personal color analysis, consumer color preferences and color forecasting for the fashion and textile industries* (2007), an improved model was put forward, which was mainly due to the inaccuracy and inefficiency of the current forecast model. In her study personal color analysis systems and color data had been taken as the foundation. Compared with the current model, the improved model adds a market research stage in order to collect consumer color preference data rather than only anticipate consumer acceptance [3].

In China, color forecasting researches could be dated back to the end of 1980's. China fashion color association (CFCA) contributes mostly to this research. Experienced color experts and pioneers like Huang Nengfu, professor of Tsinghua University, Color consultant of CFCA, Zhang Wencai, chief sectary of Jiangsu Textile and Fashion Color Association, Wu Zhengbao etc., firstly delivered the newly international trends and fashion color forecasting mythologies to Chinese. The relevant information and achievements could be seen in their latter works on color science and color application [4,8]. Meanwhile with the development of color marketing and customers' emphasis on fashion color, color forecasting enterprises are gradually booming under the efforts of enormous color researchers and experts, such as Liang Yong, Cui Wei, Zhao Jianming, Yang Dongqi etc. The fresh achievements promote efficiently the Chinese textile industries' competitive capacity and status in the international textile markets.

3. Research on Systematic Methodology

Systematic methodology is the most common method broadly applied in the color forecasting process. Many scholars and research teams engaged great efforts in the discussion of efficient models' building and provided their distinguished research ideas besides the pioneer research and contribution from Linton, Tracy and other Chinese color experts. The typical methods applied into the model's building are statistical theory, EPV method and rough set theory.

3.1 Statistical Theory Method

Deng Qingzeng, professor from Beijing University, firstly probed into this filed. In his article: *Discussion on statistical theory of fashion color* (1989) [9], he considered fashion color as a certain social phase exchange. The fashion colors were analyzed statistically by Fokker-Planck equation, conducted according to synergetic principle. Finally numerically calculated results and explanation on whether color is popular or not in the future was given.

3.2 FPV Method

In 1991, Chen Linlong pointed out a new measurement unit: FPV (Fashion preference value) to judge whether the color is popular or not. In his article: *Taking FPV method to forecast fashion color* (1991), he mentioned that the value of FPV could reflect the colors that people preferred. FPV is decided by the relative factors like: individual's culture, economic condition, social life style, psychology, local folk and customs and his social status. The relation between each factor can be seen in equation (1)

$$FPV = f(C，E，L，H，P，T) \quad FPV \in [0.1] \quad (1)$$

Where C stands for individual's culture and education; E, economic condition; L, life style, H, psychology; T, local folk and customs,

In this method the condition to judge whether the color is popular or not lies in the following statements: Supposing the setting of various people (forecaster) as
Set of People= $(P_1, P_2, P_3 \ldots \ldots, P_n)$
Each people's (forecaster)FPV toward certain color as
Set of FPV= $(FP_1, FP_2, FP_3 \ldots \ldots, FP_n)$
If the majority of people's FPV value is close to 1, then this color is popular [10].

FPV method focused greatly on the psychological factors of individuals and the customers. It was conducted based on the quantitative analyses which is different from the popular qualitative method and exerts significant influence on the latter study in China, such as Yu Ping's: *The application of computer in the forecasting and analyzing of fashion color* (2002), Cui Xiaomin's: *Research and application of mobile phone's fashion color forecasting* (2005) [11,12] etc.

3.3 Rough Set Theory Method

Rough set theory is a new effective mathematical tool to deal with vagueness and uncertainty problems. The most difference between rough set and other theories dealing with uncertain problem is that it is no necessary to provide any transcendent information about the treating data. Zhang Quan, (Doctor Candidate of computer engineering and application department of Shanghai Jiaotong University) Kang Wenke, firstly applied this theory into fashion color forecasting study. In their study: *Rough Set Based Forecasting System for Product Color* (2008), a fashion color knowledge database was built based on decision table and fuzzy set methods. Then a knowledge discovering algorithm of forecasting fashion color was presented with rough set theory and differentiability matrix theory. With the algorithm, the dependent relations between condition attributes and decision attributes based on fashion color knowledge database could be built. Finally, an intelligent fashion color forecasting system was developed, and a forecast case of clothes fashion color was implemented [13]. The results showed that this model could forecast fashion colors in short time. Figure 1 shows their innovated forecasting frame.
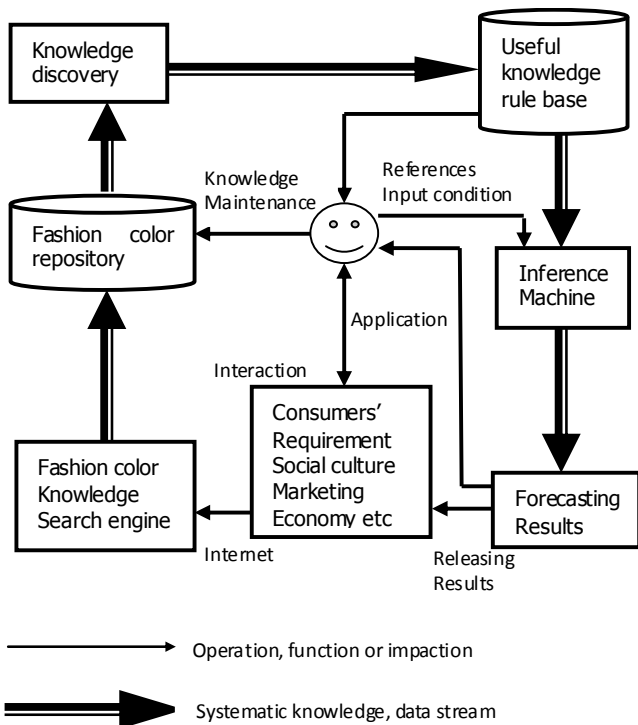

Figure 1 Forecasting system based on rough set.

From the above framework, it could be seen that this forecasting system was an open system with much consideration on the users and the outside environment (social groups). Social groups interacted with individual user, which means that social groups can exert impact on fashion color database through internet; the user can maintain and exert their impact on their knowledge database directly in turn. At the same time the systematic forecasting results can exert their function on user, product market and even the social groups too.

From the above demonstration, it can be seen that customers' emotion and color preference were the most decisive factors in the systematic researches.

4. Research on Historical Data Analysis Methodology

In Asia, Japan contributed predominantly to the fashion color research, which was founded on quantitative analysis. It firstly advanced the following results and guided the relative research:

1. Potential rules existed in the changing of fashion colors. Fashion colors changed towards their contrary directions in hue, saturation and value;

2. Fashion color's changing cycle is about 7 years: each theme of fashion colors lasts for about 3 years, and then it changes towards the opposite theme. Transition time is around 1 year. The research was partly based on the German Physicist E．Herins's tetrachromatism or so called opponent process theory. This quantitative analysis methodology and 7-year cycle theory exerted significant influence on the similar studies done latter in China.

4.1 Comparison Method

The traditional forecasting method applied by Chinese experts of CFCA since 1980s to analyze and explain the fashion colors changing direction is mainly based on the comparison between the current fashion colors and the previous ones, exclusively on fashion colors' attributes and tones. Fig. 2 shows the forecasting model (comparison of recent two years' fashion colors' attributes: hue, value and saturation). Experts and forecasters predict the future trend according to the characters of colors distribution.

Figure 2 Comparison of two years fashion colors in terms of hue, value and saturation.

4.2 Grey Theory Method

Grey system theory, founded by Prof. Julong Deng in 1982，is an innovative theory dealing with problems of uncertainty. As mentioned above, trend prediction of fashion colors is influenced by many factors such as politics, economy, culture, and public security. Apparently, it is very difficult to quantify those factors. Besides, the interactive effect among them is also uncertain. Such a state of affairs matches the condition domain the grey system can apply to. Therefore, many researches attempt to build fashion color prediction models by using grey theory.

In written files, Yu Taiwen, Wu Ruiqing from Datong Institute, firstly applied grey systems theory into the prediction of fashion color. In their research *Using grey system theory to fashion color prediction* (1987), they tried to build a prediction model GM (1, 1) to predict the next year's color trend [14]. Firstly, 2020 fashion color samples were collected, which were released by various authoritative color forecasting organizations. Then all the samples were quantified into L, a*, b* value by spectrometers: Macbeth Color –Eye 3100. Thirdly, all the samples were reflected into the NCD color image scale, and the psychological feature of each color was determined according to the NCD color space. NCD color image scale was founded by Nippon Color & Design Research Institute INC. The Color Image Scale consists of three psychological criteria (axes) that are warm - cool, soft - hard, and clear-grayish. It was widely applied into the analysis of color's psychological feature. Fig. 3 shows the Color Image Scale (Single Color),

Finally, fashion indices were extracted and defined as the time series for the GM (1, 1) model to predict the possible fashion colors' distribution in the coming years. The result revealed that the model could give valuable information: such as changing trend of the possible popular colors' in terms of hue,

saturation, value and tone. This method exerts great influence on similar research done later.

Figure 3 Color image scale (single color).

4.3 Statistical Analysis Method

In China, CFCA has done great contribution to the development of Chinese color research and application. Recently, CFCA made an analysis of Women's Spring/Summer Fashion colors, released by IC from 1995 to 2005.

In their research: *Analysis on 1996-2005 international spring/summer fashion color* [15], 359 fashion color samples were collected and quantified by using NCS system. The distribution of colors in terms of hue, value and saturation were discussed and the changing of colors' tone was analyzed. Finally intercolor changing rules and future trend were proposed. It was the first contribution operated on the information from a single forecast agency.

In 2007, Jill Stansfield and T.W. Allan Whitfield, in Seinburne University of Technology, discussed a problem that: *Can future color trends be predicted on the basis of past color trend?: an empirical investigation*. In their research the relation between color trends and prevailing social cultural lifestyle condition was discussed. Color palettes, prevailing in Australian residential interior over the twentieth century, were assembled decade by decade from 1900 to 1990. Colors were quantified by using the NCS system and then the data were analyzed. Their results indicated that the main variation during the century in the hue dimensions was greater in the second half of

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the century. And no evidence was found to support the notion of color cycles or any tangible order for color consumption. Although some color palettes could be partially accounted for it, such influences were short-lived. The results that emerged did not support the notion that future color trends can be predicted on the basis of past color trends [16].

Though the research considered greatly on the relation between the historical fashion color data and social culture, the data with nearly 100 years span puzzled the readers. It is well-known that the current fashion colors can impact the near future fashion color palettes' decision, however it can be testified just about the near two years' later. Thus how can the data comprised by decades and decades reflect the color consumption order, while going through such complicated social environment like two world wars, intricate political disorders, economic fluctuations and so on. What's more how can they avoid the samples' distortion problems due to the former printing technology and dying properties' limitation?

5. Discussion and Conclusion

As mentioned above, current researches are divided into two types: systematic analysis and historical data analysis. Results demonstrated that whatever the method and type it is, only short term fashion color trend can be predicted. Additionally some other problems should be mentioned:

(a) In Jill Stansfield's research, though it probed into the relation discussion between the fashion color and social culture, the samples and printing technology matter compromised the analysis results and cannot offer convincing grounds. Though no evidence was found to support the notion of color cycles or any tangible order to color consumption, we wonder does an index exist just as Dow Jones Industrial Average (DJIA) does to the stock.

Additionally, the situation, used by forecasters as pointers for directional changes in color mood, is unlikely to occur again simultaneously at any time, let alone in around two years, thus the weight of each relevant factor should be exerted. Although historical color data would never lend itself to be a predicting tool, it is a useful resource for understanding color moods and their sensitivity to color palettes. Consequently the database of historical fashion colors should be concerned.

(b) With the development of market segmentation, color information is specified as fashion colors for leisure wear, women's wear, men's wear and kids

wear with seasonal difference, like spring/summer and autumn/winter palettes. Are they consistent with each other? Can they be substituted by each other? Or is the information, released by different agencies, consistent with each other or can they be replaced since many of the former researches undertaken were based on various information released by different agencies.

We took 2009 spring/summer fashion colors, released by 5 authoritative agencies in the world, as objectives and discussed the similarity of the information by using Minitab15 software. Fig. 4 shows one part of our results.

From Fig. 4 we can find that three attributes of fashion colors, released by 5 different agencies, it can also be seen that there are certain differences and similarities among different agencies information.
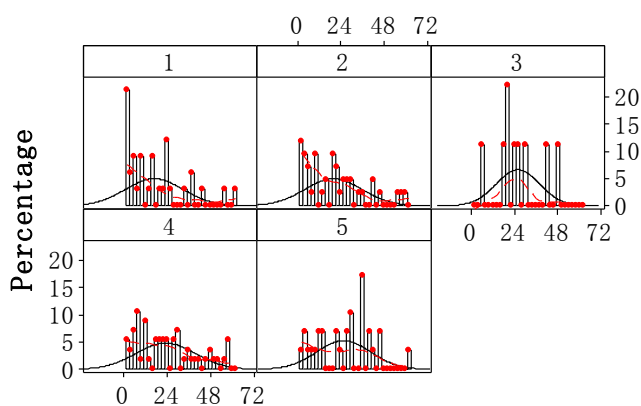
For example, we can see whatever the information is, it is presented with typical double peaks and warm-cold contrast in hue, which accords with the Japan's research results. However they are not so consistent in details. Therefore we wonder the reliability of the current research based on variance fashion color resources.
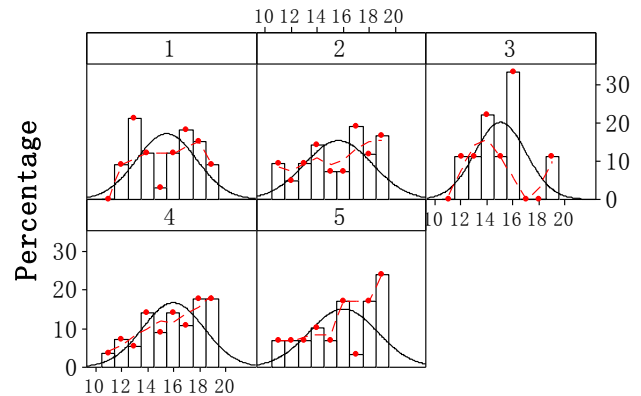
(a) Comparison of value
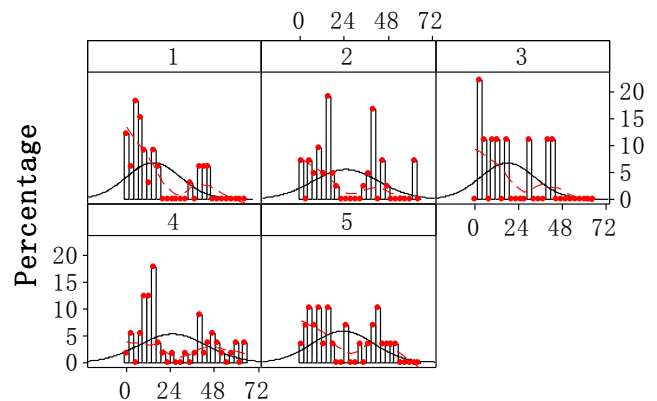
(b) Comparison of hue

(c) Comparison of saturation

Figure 4 Comparison of 5 agencies' fashion colors.

(c) Fashion colors' 7- year cycle theory showed that the samples collected within 10 years are too limited to reflect the real changing rules.

To conclude, the current researches on fashion color prediction improved much on the accuracy and reliable aspects, however they can only reflect the near future's trend in about 2 years. And the total cycle period has not been verified.

With the development of intelligent computation technology, many intelligent prediction theories and algorithms should be attempted into the building of prediction models. The combination of different prediction theories such as grey theory, rough set theory, neural network, artificial neural network, fuzzy neural networks, and support vector machines will inevitably improve the accuracy of the prediction.

Meanwhile the suggestion from the color experts and designers of the textile and fashion industries will be significantly beneficial for the smart forecasting system's building.

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