Cassidy, Tracy Diane, Westland, Stephen and Grishanov, Sergei

A Colour Selection System to Better Inform the Colour Forecasting Process

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Keywords Colour forecasting, Colour selection, Contemporary colour mixing

Abstract

Colour forecasting is a process where attempts are made to accurately forecast colour for fashion-related products that consumers will purchase in the near future. Seasonal colours are recognised as a powerful driving force of fashion-related products and consumer research of desires and preferences has become an important integral part of design and marketing processes. Trend forecasts are marketed globally by forecast companies to many fashion-related industries in order to increase their market coverage. They do not take into account colour acceptance levels of target markets on which fashion-related industries focus their design and marketing efforts. The information they sell is broad and generalised, even so, they claim to aim for 80% accuracy in their predictions. In a previous study, the anticipation of consumer acceptance was identified as the weakness of the current colour forecasting process. An improved system model, which replaced the anticipation stage with consumer colour acceptance data was conceptually developed and tested. In order to generate sales on the high street, this improved process requires accurate knowledge of consumer colour acceptance which would entail additional cost and time for the fashion industry to implement. It is therefore critical for a tool to be made available that does this part of the process for them. Hence, this research proposes to establish a framework necessary to develop and

provide such a colour selection tool that will enable the users of colour forecasting information to generate colour ranges for their products that will have greater consumer acceptance. The tool will enable fashion companies to take control of their own colour forecasting process through the colour selections they make for their ranges. Essentially the tool will benefit the UK fashion industry's competitiveness in the global market and assist waste reduction (unwanted goods) that impact on the environment.

Introduction

The purpose of this paper is to introduce the concept of a colour selection tool intended for the UK fashion industry to use as part of individual companies' colour forecasting processes. The tool will allow them to develop more favourable fashion products for their specific target markets, and thus reduce the risk of manufacturing unwanted products. The paper sets out the rationale for the tool and the framework used to develop sets of colour spheres that will be used in the subsequent phases of the research project.

Previous research had identified the weakness of the current colour forecasting process as being the anticipation of consumer acceptance of the colours selected for fashion product on a seasonal basis. The business objective of trend forecasting companies is to generate high volume sales of their trend packages. In order to achieve this there is a need to reach as wide a customer base as possible and therefore the colour trend information is generalised, broad and non-target market specific (Diane at al 2005, pp xiii). It is the task of the information user, the designer or buyer etc, to use their knowledge of the tastes of their own target market, or markets, to develop seasonal colour palettes that reflect the promoted colour trends. The anticipation of consumer acceptance of those colours is an inherent part of this process. Previous research found that only around half the population surveyed were satisfied with the colour range available to them at that moment in time. A proposed improved colour forecasting system model includes market research information to eliminate the need for the anticipation of acceptance. The feedback from the fashion industry was favourable for the new system as an improvement to the process but concerns were made regarding the time needed to undertake this stage. It therefore makes better sense for the industry to have access to a tool that does this part of the process for them. In order to achieve this, a framework is required that will enable the development of a tool that will then enable colours to be selected for ranges that will yield high levels of consumer acceptance for fashion products on a seasonal basis. Through further phases of the research project, a designer-friendly, target market-specific colour selection tool intended for companies to take control of their own colour forecasting process can then be developed.

The scope of the tool

The colour tool will enable certain sets of data (input) to be entered into the system such as the designer's observations, past sales colour data (both high and low sales), trend data (purchased or from trade fairs, suppliers, etc) and intuitive notions of colour. While it will be possible to incorporate trend information as an input into the system, the tool itself is not intended for the trend forecasting sector as the target markets for this sector's product (the trend prediction packages) has a global reach comprising general information which is intended to be inspirational, though reflecting globally-marketed seasonal colour directions. However, that is not to say that it would not be a useful tool for this sector to use to help develop harmonious colour stories. The tool will use sets of tested consumer colour acceptance data to process or transform the input data into a selective and relevant colour gamut (outputs) from which colour options can be further selected to create palettes of high acceptance for a particular target market without compromising designers' intuitive notions.

Methodology

This research programme proposes a new method for generating a series of colour spheres to be developed through knowledge of the nuances of colour bias as a framework for the proposed colour selection tool. An iterative process of experimentation, testing and refinement throughout the stages of development will be necessary. The research will be conducted in a series of research phases after optimal primary colours have been selected in accordance with advanced colour mixing theories. Initially, a framework in the form of a set of theoretical generic colour spheres developed from contemporary colour pigment mixing approaches is required as the foundation for the research. The rationale and development of this framework is described in this paper. Following this, experimental research using this framework will be conducted to develop the actual colour spheres. Basic colour mixing theories are familiar to designers, contemporary colour mixing theories use a limited set of primary colours to enable an optimum range of colour spheres to be developed, this approach will benefit both the designer and the colour technician. The colour spheres will then be used for the consumer testing stage in the second phase of the research project. This stage will serve to address the first two research questions set out below. Subsequent phases will use the consumer tested data to refine the colour spheres in relation to target market demographics. The colour gamut will then be simulated in a range of virtual and physical fabrics and garments for further consumer testing to ascertain any significant differences in acceptance of identical colours on different product types. This will provide the link between the demographical consumer colour acceptance data and colour acceptance for specific fashion products prior to the design and development of an appropriate interface for the tool.

Research questions

The project poses a set of key research questions that will be answered in the second phase of the research (consumer testing), these are:

- At what point does a colour become unacceptable to purchase?
- Does a colour with a different colour bias have the same level of acceptance?

Further research questions that will enable the tool to be product-specific will be addressed through further consumer testing, these are:

- Do different fibres and fabrics of the same colour have a similar level of acceptance?
- Do different fashion products of the same colour have the same level of acceptance?

How all of these acceptance levels can be mapped and managed to produce the proposed tool will be the subject of the final phase where the interface will be designed and developed. As the tool will be used by designers who use subtractive mixing theories for pigments and dyes as opposed to additive mixing (colour light mixing) which is used by computers, it may be necessary to produce colour samples using subtractive mixing and measuring the resulting colours to be input into the software system, this will be determined in the latter stages of the research project.

Traditional colour mixing theories

Traditional colour mixing theories for pigment mixing, known as subtractive colour mixing (Chiazzari 1999, pp13) is based on the concept of true colour (Wilcox 2001, pp19). The 12-hue colour wheel traditionally has three primary colours red, yellow and blue (Lidzey et al 2002, pp 8) and when mixed together in equal amounts produce black, or near black (Wilcox 2001, pp20). In reality we do not have true primary colours they all have some degree of impurity known as colour bias (Wilcox 2001, pp21) which is often referred to as colour temperature (Cheskin 1951, pp202-3). The colour wheel provides a basic colour mixing tool to understand basic subtractive colour mixing without the complication of colour bias (Birren 1987, pp11-22). Therefore using this traditional colour mixing wheel the colourist will randomly select primary colour representations as the colour bias will not have been taken into account. The colourist will then produce further random mixed colours having no control over the inherent colour biases (Wilcox 2001, pp23). For example when mixing red and yellow to produce an orange if neither the red nor the yellow used has a blue bias then a clean orange will be produced. However, if one of the primary colours has a blue bias then an orange with a slightly muddy appearance will result, and a very muddy orange will result if both primaries have a blue bias (Birren 1987, pp26). The degree of muddiness will therefore depend on the levels of impurities in each of the primary colours. In essence, secondary and tertiary colours with slightly different appearances are possible because of the nature of the colour bias of individual colours used in the mix (Wilcox 1987, pp9). The questions to be answered here are how do acceptance levels differ for these variances of colour? Can these acceptance levels be mapped out in relation to demographics? Furthermore, how do the acceptance levels of the differing colours relate to fashion product? In order to develop the proposed colour selection tool answers to these fundamental questions are essential and therefore initial research into consumer colour acceptance is crucial. Consequently, sets of colours or colour spheres need to be developed in order to test acceptance, as colour bias affects the appearance of colours and contemporary colour mixing theories take colour bias into account, these colour theories will better inform the development of the colour spheres.

Contemporary colour mixing theories

Contemporary colour mixing takes the colour bias of individual colours into account to control and achieve the desired colour quality. Each primary colour therefore has two colour bias possibilities, each leaning toward one of the other two primaries (Wilcox 2001, pp23). For instance, red may have a blue bias or a yellow bias. Therefore, unlike traditional colour mixing theory that uses three primary colours, contemporary colour mixing uses six primary colours (Wilcox, 1987, pp15-19). For ease of clarification each of the six primary colours has been categorised as shown below in table 1.

Table 1 The six primary colours of contemporary colour mixing

Bias 1	Traditional Primary Colour	Bias 2
Blue Bias (Blue-Red) Red 1	Red	Yellow Bias (Yellow-Red) Red 2
Blue Bias (Blue-Yellow) Yellow 1	Yellow	Red Bias (Red-Yellow) Yellow 2
Red Bias (Red-Blue) Blue 1	Blue	Yellow Bias (Yellow-Blue) Blue 2

Building a colour wheel

Using traditional colour theories a colour wheel begins by plotting the three primary colours red, yellow and blue equidistantly around a circle (Whelan 1994, pp9). These are subsequently mixed in pairs to produce a set of three resulting secondary colours, orange, green and purple (or violet) which are plotted between the two primaries used to produce them (Holtzschue 2002, pp48). As contemporary colour mixing employs six primary colours the colour wheel would look too complex if all were plotted on one circle as there are a total of eight possible sets of three primary colours, these are:

- Red 1, Yellow 1, Blue 1 (Colour Wheel 1)
- Red 1, Yellow 1, Blue 2 (Colour Wheel 2)
- Red 1, Yellow 2, Blue 1 (Colour Wheel 3)
- Red 1, Yellow 2, Blue 2 (Colour Wheel 4)

- Red 2, Yellow 1, Blue 1 (Colour Wheel 5)
- Red 2, Yellow 1, Blue 2 (Colour Wheel 6)
- Red 2, Yellow 2, Blue 1 (Colour Wheel 7)
- Red 2, Yellow 2, Blue 2 (Colour Wheel 8)

It can also be seen in table 2 below that due to the colour bias options of the primary colours shown previously above in table 1 that four different qualities of secondary colours can be produced. Therefore a contemporary colour mixing wheel would have twelve secondary colours not three as in the traditional colour wheel.

Table 2 Secondary colour options from contemporary colour mixing theories

Red + Yellow = Orange	Red 2 (Yellow Bias) + Yellow 2 (Red Bias) = ORANGE 1 (Yellow/Red-Orange)	Red 1 (Blue Bias) + Yellow 1 (Blue Bias) = ORANGE 2 (Blue/Blue-Orange)
	Red 1 (Blue Bias) + Yellow 2 (Red Bias) = ORANGE 3 (Blue/Red-Orange)	Red 2 (Yellow Bias) + Yellow 1 (Blue Bias) = ORANGE 4 (Yellow/Blue-Orange)
Yellow + Blue = Green	Yellow 1 (Blue Bias) + Blue 2 (Yellow Bias) = GREEN 1 (Blue/Yellow-Green)	Yellow 2 (Red Bias) + Blue 1 (Red Bias) = GREEN 2 (Red/Red-Green)
	Yellow 2 (Red Bias) + Blue 2 (Yellow Bias) = GREEN 3 (Red/Yellow-Orange)	Yellow 1 (Blue Bias) + Blue 1 (Red Bias) = GREEN 4 (Blue/Red-Green)
Blue + Red = Purple	Blue 1 (Red Bias) + Red 1 (Blue Bias) = PURPLE 1 (Red/Blue-Purple)	Blue 2 (Yellow Bias) + Red 2 (Yellow Bias) = PURPLE 2 (Yellow/Yellow-Purple)
	Blue 2 (Yellow Bias) + Red 1 (Blue Bias) = PURPLE 3 (Yellow/Blue-Purple)	Blue 1 (Red Bias) + Red 2 (Yellow Bias) = PURPLE 4 (Red/Yellow-Purple)

A set of rules can be stated for the resulting secondary colour possibilities concluded from the information above in table 2:

- Secondary colour 1 – with harmonious colour biases

  Two primary colours having the colour bias of the other colour in the mix will always produce a clean, bright secondary colour as the mix will not contain any of the third or unused primary colour. For example, the red used to mix orange 1 has a yellow bias and the yellow has a red bias.

- Secondary colour 2 – with a complementary colour bias

Two primary colours with the same colour bias will always produce a secondary colour with the same colour bias as those used in the mix. For example, orange 2 has a blue/blue colour bias as both of the primary colours used in the mix have a blue bias. As the colour bias will always be the unused of the three primary colours, otherwise known as the colour complement of the resulting secondary colour, the resulting secondary colour will be muddy. The stronger the colour bias (larger the amount), the more the secondary colour will move towards a coloured neutral.

- Secondary colours 3 and 4 – with one complementary bias and one harmonious bias

The first primary colour having the colour bias of the resulting secondary colour's complementary colour (opposite on the colour wheel) and the second primary having the colour bias of the first primary colour in the mix. For example, orange 3 uses a red with a complementary blue bias and a yellow with a harmonious red bias and the resulting orange has a blue / red bias. Orange 4 uses a red with a harmonious yellow bias and a yellow with a complementary blue bias, resulting in an orange with a yellow/blue bias. As both resulting secondary colours have a small quantity of complementary blue neither will be as clear as orange 1 but nor will they be as muddy as orange 2.

In traditional colour mixing adding red and yellow to make orange we expect the resulting orange to be clean and bright, this will only happen if we mix two primaries that do not have a blue bias i.e. orange 1 in table 2. What is not known as yet is which of the secondary colour options are better favoured by which target market sectors and the acceptance levels in relation to fashion product, similarly with the tertiary and further intermediary colours.

Tertiary colours

In traditional colour mixing theories there are six tertiary or intermediate colours, red-orange, yellow-orange, yellow-green, blue-green, blue-purple; more commonly known as blue-violet and red-purple; more commonly known as red-violet (Birren 1987, pp19). Each is achieved by mixing the adjacent primary and secondary colours on the colour wheel in equal amounts, for example primary blue and its adjacent secondary colour green when mixed together in equal parts results in a blue-green (Whelan 1994, pp8) often referred to as turquoise. Ideally, the tertiary colours will have the appearance of a colour that is exactly equal in both colours, an exact mid-way point between the two on the colour wheel. This ideal resulting colour should contain 50% of one pure or true primary colour, 25% of a second pure primary colour and 25% of the remaining pure primary colour (Holtzschue 2002, pp49). In contemporary colour mixing theories because we have two options for the primary colour, each with a different colour bias and a choice of four secondary colours, we also have eight possible tertiary colours for each of the traditional six tertiary colours. For example, to produce red-orange any one of the following combinations can be used:

- Red 1 + Orange 1 = Red-Orange 1
- Red 1 + Orange 2 = Red-Orange 2
- Red 1 + Orange 3 = Red-Orange 3
- Red 1 + Orange 4 = Red-Orange 4
- Red 2 + Orange 1 = Red-Orange 5
- Red 2 + Orange 2 = Red-Orange 6
- Red 2 + Orange 3 = Red-Orange 7
- Red 2 + Orange 4 = Red-Orange 8

It should now be easy to comprehend that so many colours on one colour wheel would be far to complex to be of any use. Therefore, for the purpose of developing colour spheres linked to consumer colour acceptance for the development of the proposed colour selection tool, it will be most beneficial to produce a range of separate colour wheels for consumer testing. Each of the eight tertiary colour options for each of the traditional six tertiary colours, the four secondary options for each one of the traditional three secondary colours and the two primary options for each of the three traditional primary colours will be compiled into a complete range of twelve-hue colour wheels which are to be referred to as colour spheres because they move towards being used as a set of consumer colour acceptance tools rather than colour mixing tools.

Conclusion

This paper has set out the framework for developing a set of colour spheres that will be used in future phases of a research project that will endeavour to make available a tool for fashion companies to use to produce products with high levels of consumer colour acceptance. Contemporary colour mixing theories were favoured over traditional colour theories as the all important colour bias of colours is taken into account that changes the appearance of resulting mixed colours. The rationale for the colour selection tool supports the economic, environmental and social issues to which the industry is increasingly in need of responding to. It is envisaged that the needs of the fashion-consumer can be better met by optimising the current colour forecasting process through an improved colour selection process enabling the development of seasonal colour ranges with more assured levels of consumer colour acceptance. In this way the tool will benefit the UK fashion industry's competitiveness in the global market and reducing the waste of unwanted products that impact on the environment. On completion of the entire research project significant knowledge will be contributed to the field of consumer colour acceptance for fashion-related products. In addition, it will potentially optimise colour forecasting resulting in a market-led process capable of achieving highly favourable fashion products having financial gain for the industry. However, the tool will still allow for intuitive, creative and inspirational colour selections.

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