Investigation of designers' colour selection process

Yun Chen; Luwen Yu; Stephen Westland; Vien Cheung

Abstract

Although many design process studies and design theories have been developed and presented, in reality designers have rarely followed standard rules. A design process is often more a form of personal self-expression. The type of approach that designers use in their design work depends on their preference, experience and education background. Therefore, this work focused on understanding the design process and the colour selection method by collecting data from designers and their design process with the aim to summarise a general colour selection method. This work employs a semi-structured interview approach in a one-to-one interview format to investigate the process of design and collect their colour selection method. A total of twenty designers were interviewed from different design areas, working experience, age groups, cultural background and workplace around Korea, China, South Africa, Mexico and the United Kingdom. In the end, a three-step-method of colour selection was summarised and this highlighted the importance of colour association in the colour selection process.

Keywords: Colour Selection, Design Process, Colour Association.

1 Introduction

Colour is a fundamental element by which humans recognise objects in nature[1]. It is also a non-verbal communication in the most immediate form[2]. It contains multiple types of information and is widely used in Art and Design. In short, colour plays an irreplaceable role in most design fields and has long been considered to be a basic design element in art and design over at least five centuries[3]. Additionally, colour can also be regarded as a flexible and powerful tool in design. It may be viewed as a kind of language that serves as a form of communication between humans and their surroundings[4]. Kandinsky[5] reported two kinds of value that colour can provide: visual value (physical effect) and associative value (psychological effect). In particular, it has been suggested that almost 80% of the human brain is concerned with responding to visual stimuli[6], and as significant proportion of our brain and eyes are involved in processing that lead to the perception of colour[7]. Colour is defined as an essential aesthetic responses in emotional reaction which has the ability to help designs become attractive[8,9]. In terms of colour itself, while acknowledging the crucial impact of visual aesthetics[3,10], the impact of colour psychology (such as colour emotion and colour meaning[3]) cannot be neglected in design.

Colour selection is the process by which a designer selects colours for a particular design solution. The essential role of colour for design is undoubted[11,12] and colour selection is often a critical factor that can affect whether a design is successful or not[13]. Although many design process studies and design theories have been presented, in reality designers rarely follow standard rules[14]; the design process is often more like a form of personal self-expression. The type of approach that designers use in their careers depends on their personal preference, experience and educational background[15]; for example, it has been suggested that colour use in architecture is influenced by the designer's own prejudices towards colour use and their level of colour education[16]. Some studies have explored the relationship between colour use and the design process more generally[17]. However, in this study, the focus is on how designers choose colours

within the context of their design practice and this is explored using interviews.

This work in this paper employs a semi-structured interview approach, in a one-to-one interview format to investigate the process of design and designers' colour-selection methods. Both quantitative and qualitative data are collected. A total of twenty designers were interviewed from different design areas, working experience, age groups, cultural background and places of work around Korea, China, South Africa, Mexico and the United Kingdom. Grounded Theory method[18,19] and TF-IDF[18,19] data analysis method were carried out in interview data analysis. A three-step approach of colour selection was summarised in this study.

2 Research Aim

This study aims to investigate the general colour selection methods in the design process. According to the research aim, one main research question and three sub-research questions are considered (see Table 1).

Main research question	Sub-research questions
RQ 1: What is the general process of colour selection for a designer?	RQ 1.1: Is the level of difficulty in colour selection different for different levels of designers?
	RQ 1.2: What are the references when designers choose colour?
	RQ 1.3: Are there any similarities in the colour selection methods of different designers?

Table 1 Research questions for this study

3 Method

This work uses a semi-structured interview method, in a one-to-one interview format, to investigate the virtual process of design and identify the colour-selection method of designers. Both quantitative and qualitative data were collected in this study.

Structured interviews, semi-structured interviews and unstructured interviews are the three main types of interviews used in research[20]. Structured interviews use predetermined questions in a fixed order and additional irrelevant conversation is not recorded. For semi-structured interviews, the list of questions also needs to be prepared but it is flexible and any valuable extended information could be included. Unstructured interviews are rarely used in information collection, but can be used to assist in consulting services[21]. The semi-structured interview approach was chosen in this study to collect an in-depth understanding from designers and the extended response[15] will be included following the research structure.

To understand the individual design process and colour-selection method for each participant, a one-to-one interview format was selected rather than a group interview. In addition, face-to-face was chosen as the communication type. Although there are some limitations of face-to-face communication (the location is fixed, participant recruitment is usually from one city, etc.), participants may be more cooperative than those engaged by telephone or other electronic media[22].

3.1 Participants

Due to the study focus on collecting data about designers and their design process, the target participants were required to have design working experience and/or a design educational background. The 20 participants were from different countries (seven from China, six from South Korea, four from the United Kingdom, two from Mexico and one from Africa). In this study cultural difference was not important and all participant

designers had a Western design knowledge (they all had Western education background) and the majority of them had been involved with multinational project (especially the Western countries) in their career. In addition, the twenty participants were from various design disciplines (product design, graphic design, fashion design, information design, interior design and service design). The design discipline was not a factor while recruiting the participants, because this work focuses on collecting general data about the design process and colour-selection methods. The profiles of interviewed designers are shown in detail (Table 2).

Participant	Years of design experience	Design areas	Countries
1	More than 10 years	Graphic Design	South Korea
2	More than 10 years	Graphic Design	South Korea
3	More than 10 years	Service Design	South Korea
4	More than 10 years	Interior Design	South Korea
5	More than 10 years	Product Design	South Korea
6	More than 10 years	Product Design	Africa
7	More than 10 years	Interior Design	Mexico
8	5 – 10 years	Fashion Design	British
9	5 – 10 years	Fashion Design	Mexico
10	5 – 10 years	Information Design	British
11	5 – 10 years	Graphic Design	China
12	5 – 10 years	Product Design	China
13	5 – 10 years	Graphic Design	China
14	5 – 10 years	Product Design	China
15	Less than 5 years	Graphic Design	South Korea
16	Less than 5 years	Graphic Design	British
17	Less than 5 years	Product Design	China
18	Less than 5 years	Information Design	China
19	Less than 5 years	Information Design	China
20	Less than 5 years	Fashion Design	British

Table 2 Description of interviewed participants

3.2 Interview

All interviews took place in the PhD meeting room in the School of Design (University

of Leeds). Each interview was generally around 40 – 90 minutes and consisted of two parts: collection of participants' personal information and the main questions in the interview. Both parts were printed to record the interview notes. In the main question part, the research questions and aims were transformed into interview questions as shown in Figure 1.
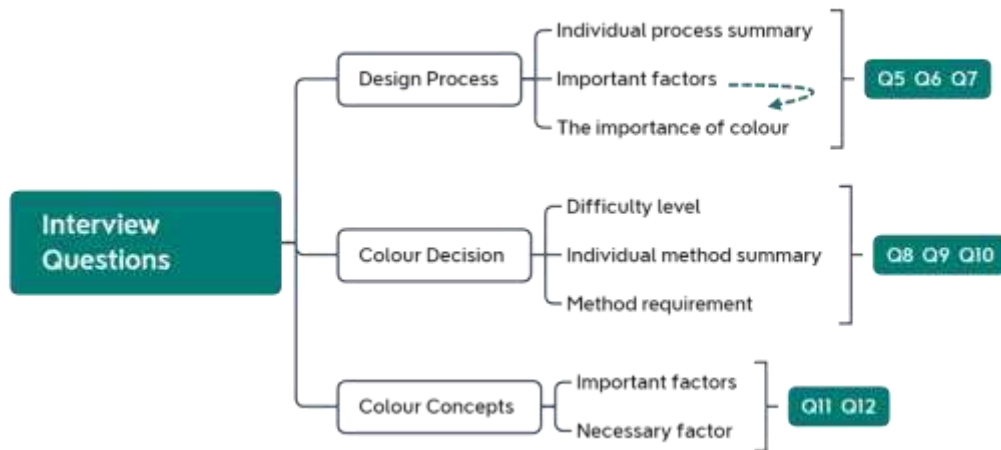

Figure 1 Relationship between the questions asked in the interviews and the research questions in this research

Fine details of the interview format were considered to optimise the interviewee experience; for example, the time dedicated for each question and the amount of questions in total were considered. An initial pilot test was carried out to address this with two PhD students (each had a design background and were students in the University of Leeds). The final version of the interview contained twelve ordered questions (Table 3).

Number	Questions	Question Aim
1	Gender (interviewer labelled)	
2	What is your nationality?	*Personal*
3	What is your working field?	*information*
4	How long have you worked in design?	
5	Could you tell me your general design process in your work?	*Design process*

6	Which aspects do you consider in your design process?	
7	Is colour an important aspect you need to consider in your design? Why?	
8	Is it an easy or difficult process of colour choosing for you? Why?	
9	How do you decide colour in your general design process?	*Colour decision*
10	Do you need a method to help you in selecting colour?	
11	In your design experience, what are important colour factors?	*Colour concepts*
12	Which concepts do you typically consider when choosing colour?	

Table 3 Interview questions

3.3 Data Preparation and Analysis Method

Data coding method - Grounded Theory Method

In this study, the Grounded Theory Method was used to organise the data. This method helps to build the main idea or the explanation around a theme from the research data[23]. There were five sequential steps of data organising:

1) Recoding materials collection

The first step of the data organising is to build an interviewee-library for each participants. Collecting the participants' information and different types of recording materials into each interviewee-library correspondingly.

2) Open coding 1

The original data consists of audio recordings and handwriting notes for each interview. This step transcribed different types recording materials into text with labels for each interview.

3) Open coding 2

Re-editing the text materials from last step. Deleting the contents which are irrelevant to the subject and gathering any words or phrases which are related to design and colour.

4) Selective coding

Developed the principal categories and related subcategories according to the research aims. Coding the materials word by word, phrases by phrases into different categories.

5) Summary

Collecting the high frequency words and summarising the main information from the coded data.

Data analysis method – TF-IDF

In this study, most of the data is qualitative data. The TF-IDF[24] statistical method was used to translate the qualitative data into an analytical visual result. TF-IDF stands for term frequency-inverse document frequency, and the TF-IDF weight is a weight often used in information gathering and text mining. This weight is a statistical measure method specialised for evaluating the importance level of a word to a document in a collection or corpus. In a target document, TF (Term Frequency) means the frequency of a specific words in the document; IDF (Inverse Document Frequency) represents the general importance level, TF-IDF weight is multiply by TF and IDF, Eqn:

$$w_i = tf_{i,j} \times df_i = \frac{n_{i,j}}{size\ (j)} \times log\frac{|D|}{|\{j:ti\in dj\}|}$$

Therefore, the high frequency of the words in a particular file can produce a high-weight TF-IDF. In this study, all the results from 20 participants were organized together by each interview question. The high frequency of the words which were mentioned under each question were collected by measuring the TF-IDF weight. Then, the main opinions were summarised by the high frequency words for each question.

4 Results

The main part of each interview contained 8 questions (Q5 ~ Q12) which related to

three topics: 1. Design Process; 2. Colour Decision; 3. Colour Concepts.

4.1 Design Process

Question 5: Could you tell me your general design process in your work?

During the interviews, each participant described each step of their normal design procedure in detail. According to the TF-IDF weight, high frequency words were collected for each design step. As a result, four steps in the design process were identified as: 1) topic decision; 2) related concepts; 3) ideas creative; 4) draft improvement (Figure 2).
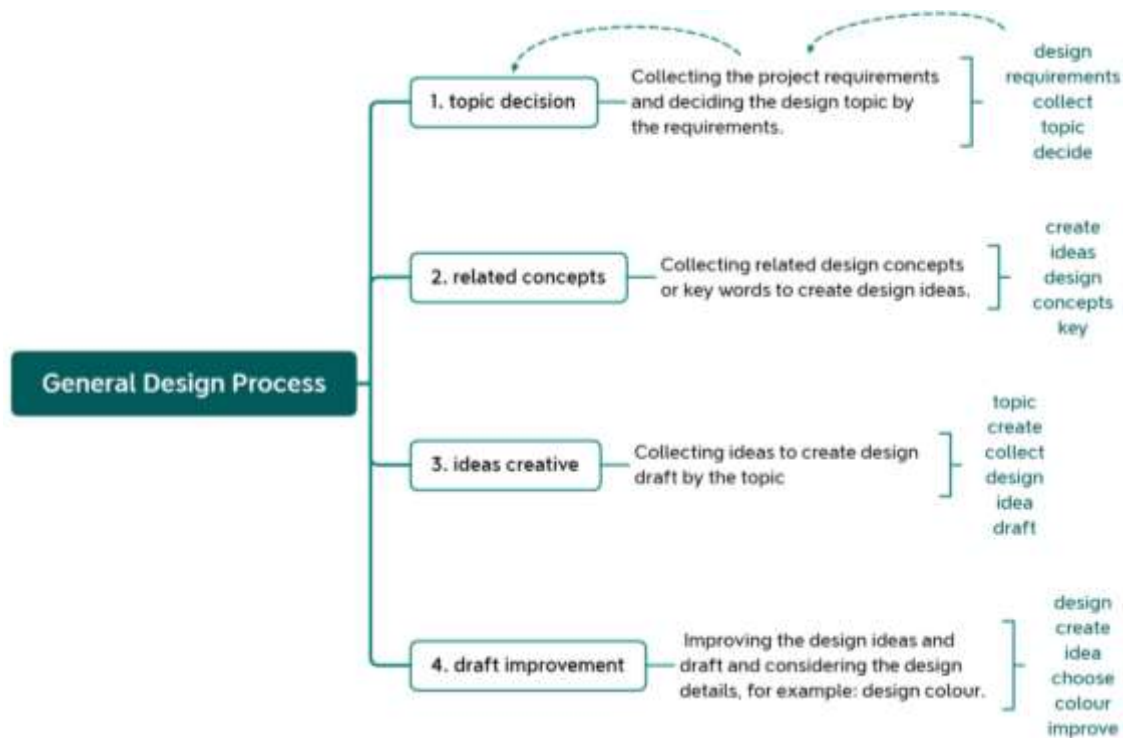

Figure 2 General design process summarised

Question 6: Which aspects do you consider in your design process?

The purpose of this question was to collect the main factors which designers normally consider and understand the important factors for design. Therefore, the interviewer collected the main words mentioned during their response. As Figure 3 shows, 'colour' was the most frequently mentioned word and with the highest weight value which suggests that colour is the most important factor during their design process. After

'colour' the following words were next in terms of frequency: 'design', 'topic', 'materials' and 'requirements'.
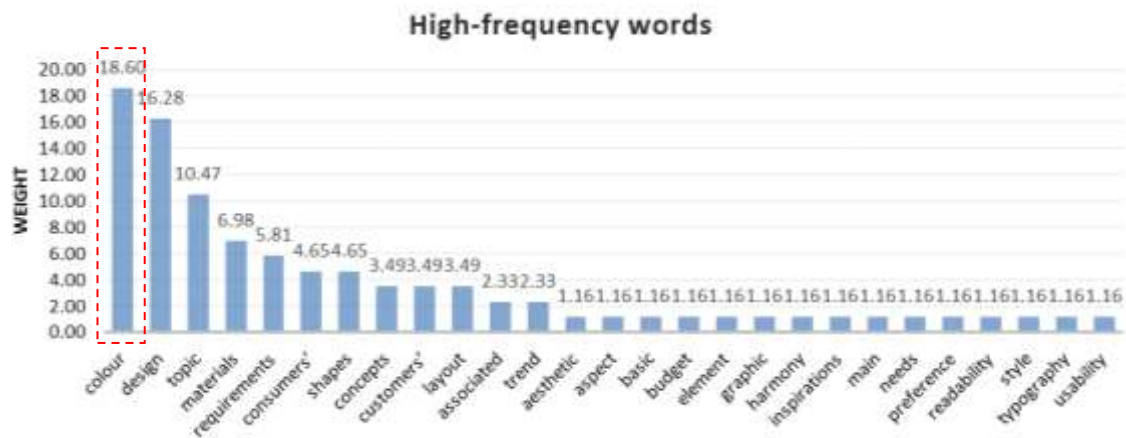

Figure 3 Words collection of the main factors which designers normally considered

Question 7: Is colour an important aspect you need to consider in your design? Why?

This question is about the importance of colour as a factor in design and to understand the reason why it might be. All participants responded that colour is an important factor and they always considered colour during their design process. This reinforces the finding from question 6 but also revealed the following high-frequency words: 'design', 'colour', 'influence', 'directly', and 'whole'.

4.2 Colour Decision

Question 8: Do you find it easy or difficult to choose colours? Why?

This question gather ideas about whether colour decisions are easy or difficult. 30% of participants chose easy and 70% of participants think it is difficult. The reasons for their choice were collected and the typical words were enumerated. For the 30% participants that think colour selection is easy for them, the high-frequency words were 'colour', 'choose', 'concept', 'experience' and 'material'; they could easily choose colour according to the design concept and materials, or by their personal experience. In another group, for the 70% participants which think colour selection is difficult for them,

the typical words of their reasons were: 'colour', 'hard', 'find', 'choose', 'match', 'experience', 'topic' and 'understand'.

Question 9: How do you decide colour in your general design process?

The aim of this question is to understand the process of colour-selection and generate insights towards a general method from their responses. Participants introduced their normal approach of choosing colour in detail and all the answers were organised into discrete steps. According to the TF-IDF weight, the high frequency words were collected by each step. As a result, a three-step colour-selection method was deduced as: 1) topic decision; 2) related concepts;3) colour selection (illustrated in Figure 4).
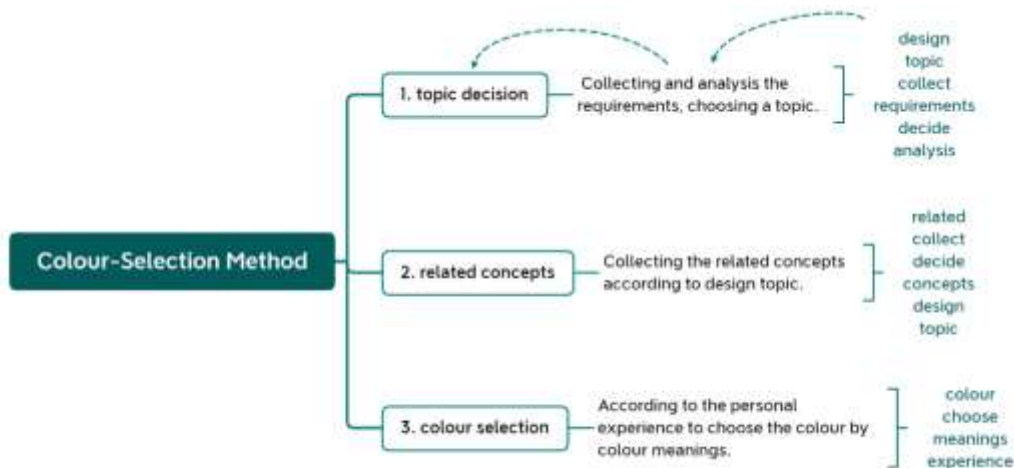

Figure 4 The three-step colour selection method

Question 10: Do you need a method to help you in selecting colours?

This question enquires whether designers need a normative method to help them choose colour. Most participants (N=17) said they need a method to help them but a minority of participants (N=3) said they did not require such a method.

4.3 Colour Concepts

Question 11: In your design experience, what are important colour factors?

The purpose of this question was to collect the main colour factors which they normally considered. Therefore, the main words which be mentioned with high frequency were collected from their answers. As the chat shows that (Figure 5), 'colour' and 'meaning' were the highest frequency mentioned words which means colour meaning is the most important colour factor they always considered. In addition, 'brightness', 'harmony', 'material', 'preference', 'aesthetics', 'consumers' and 'saturation' were mentioned as well.
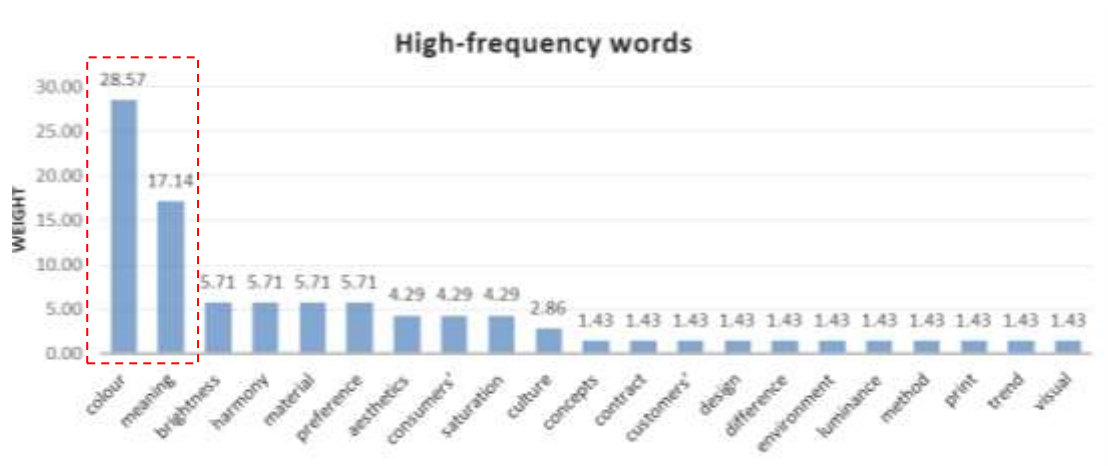

Figure 5 Words collection of the important colour factors

Question 12: Which concepts do you typically consider when choosing colour?

Following question 11, this question requested participants to choose one factor which they think is the most important factor that influences their colour selection. The main words were collected and can be seen in Figure 6. Obviously, colour meaning is the most frequent factor that they considered and which influenced they colour selection.
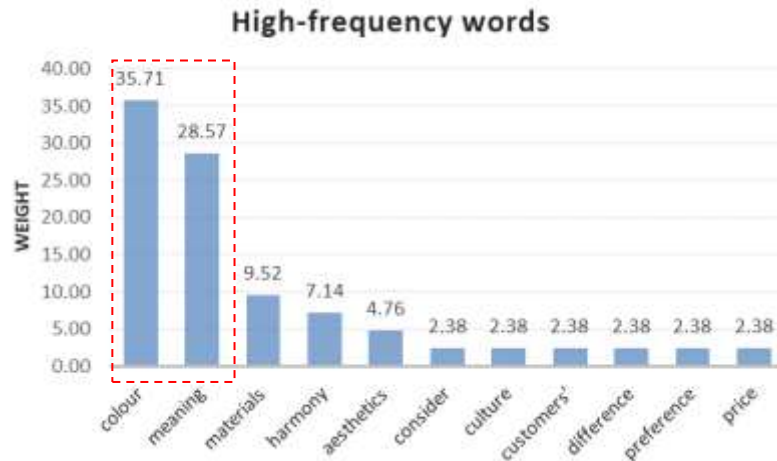
Figure 6 Words collection of the most important factors

5 Discussion and Conclusion

Some studies have explored the relationship between colour use and the design process more generally[25]. However, in this study the focus is on the design process understanding and how designer choose colour within the context of their design practice. It is explored through an interview study to collect new research data from the designers and gathering the ideas from their routine design work.

First of all, this study summarised a general design process from the designers. Even though the participants were from different design areas and had varying design experience, some obvious similarities in their design process were identified. Four steps were identified in the design process: 1) topic decision; 2) related concepts; 3) ideas creative; 4) draft improvement. It was also evident from the study that colour is the most important factor during the design process and that colour directly influences the whole design. Some research has identified that colour is considered rather late in the design process[26]. However, the findings in this study are more consistent with other findings that colour is considered by designers at all stages in the design process from the very beginning[27]. It is possible that a more detailed analysis involving many more participants might reveal differences in this regard between different design disciplines

but such an analysis was not possible using the number of participants upon which this study was based.

In the following, the process of colour decisions is investigated. The colour selection process was gathered in a clear method. Twenty designers described their personal approach but the answers carried many associations and could be summarised as a three-step-method: 1) topic decision - collecting and analysing the requirements and choosing a topic; 2) related concepts - collecting the related concepts according to the design topic; 3) colour selection – choosing colours based on colour meanings and according to personal experience. In addition, this study also collected some related information of colour selection. From the view of practical design work of the participants, it is not easy for most of them (70%) to choose design colours and selecting appropriate colours to match the design topic is the hardest step for them (RQ1.1). They normally chose colour according to the design concept and colour meaning, by their personal experience. Colour meaning is the most important colour factor they considered during the colour-selection process (RQ1.2)(RQ1.3).

Therefore, this study was further evidence that the importance of colour, it also indicated, for a large proportion of designers, they may face the difficulty of colour selection. Thus, the three-step-method could provide a clear and effective idea of how to choose colour, especially for the junior designers or the people do not have design background. Besides, based on this three-step-method, it is noticed the colour selection process is the process from specific concept to colour (Figure 7). That is, finding associated colours for specific concepts or design topic which is based on colour association.
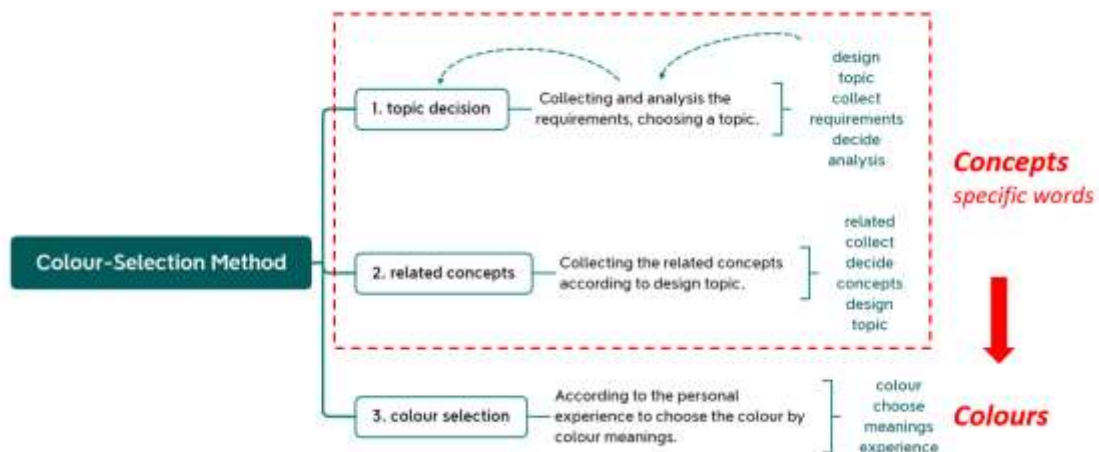
Figure 7 Three steps colour selection method

Colour association is not a unknown concept in colour research. It is established that strong associations exist between colours and concepts[28]. The term 'association' refers to present a connection or cooperative link between someone or something[29]. Colour association expresses a specific relationship between colour and concepts or objects. It is noticed colour associated is often discussed as a single relationship which is from colours to concepts, such as colour emotion[30] and colour meaning[31]. However, colour association is bidirectional which could represent the relationship from colour to concept or from concept to colour, due to the essential meaning of the term 'association'[29]. Colour association from concept to colour is important and deserves further investigation. This study indicated one application of this kind of association which is in the design area. The colour associations from concept to colour is important in design and understanding this process may lead to enhanced tools for colour selection.

References

1.   Goethe, J. W. V., & Eastlake, C. L. (2006). Theory of colours. Dover.

2.   Ambrose, G., & Harris, P. (2005). Basics design 03: Typography. AVA Publishing.

3.   Osborne, R. (2012). The history of colour theory in art, design and science. In Colour Design (pp. 309-335): Elsevier.

4.   Sherin, A. (2012). Design elements, Color fundamentals: A graphic style manual for understanding how color affects design. Rockport Publishers.

5.   Kandinsky, W. J. M. S. (1977). Concerning the Spiritual in Art, trans. 19.

6.   Lightfoot, C. and Gerstman, R. (1998) 'Brand Packaging', in S. Hart and J. Murphy (eds) Brands: the New Wealth Creators, pp. 46–55. Basingstoke: Macmillan.

7.   Gegenfurtner, K. R., & Kiper, D. C. (2003). Color vision. Annual review of neuroscience, 26(1), 181-206.

8.   Abbott, M., Holland, R., Giacomin, J., Shackleton, J. J. J. o. P., & Management, B. (2009). Changing affective content in brand and product attributes. 18(1), 17-26.

9.   Rocchi, B., & Stefani, G. J. I. J. o. W. M. (2006). Consumers' perception of wine packaging: a case study. 18(1), 33-44.

10. Zelanski, P., & Fisher, M. P. (1999). Colour: Herbert Press.

11. Grossman, R. P. and Wisenblit J. Z. (1999), What we know about consumers' color choices. Journal of Marketing Practice , 5 (3), pp. 78-90.

12. Ares, G., & Deliza, R. (2010). Studying the Influence of Package Shape and Colour on Consumer Expectations of Milk Desserts Using Word Association and Conjoint Analysis. Food Quality and Preference, 21, 930-937.

13. Adams, R. J. (1987). An evaluation of color preference in early infancy. Infant Behavior and Development, 10(2), 143-150. doi:10.1016/0163-6383(87)90029-4.

14. Bengtsson, A., & Grahn, P. (2014). Outdoor environments in healthcare settings: A quality evaluation tool for use in designing healthcare gardens. Urban forestry & urban greening, 13(4), 878-891.

15. Muratovski, G. (2015). Research for designers: A guide to methods and practice. Sage.2-3.

16. Motamed, B., & Tucker, R. (2018). Colourful practice: Is design education informing architects' use of colour?. International Journal of Technology and Design Education, 28(4), 1001-1017.

17. Smith, G., & Whitfield, T. A. (2005). The professional status of designers: A national survey of how designers are perceived. The Design Journal, 8(1), 52-60.

18. Thornhill, A., Saunders, M. and Lewis, P., 2009. Research methods for business students. Essex: Pearson Education Ltd.

19. Tracy, S.J., 2019. Qualitative research methods: Collecting evidence, crafting analysis, communicating impact. John Wiley & Sons.

20. Robson, C. (2002). Real world research : a resource for social scientists and practitioner-researchers (Second edition. ed.). Oxford: Blackwell Publishers.

21. Marshall, G. and Jonker , 2011. An I ntroduction to I nferential S tatistics: A R eview and P ractical G uide. Radiography. 17(1), pp.e1 e6.

22. Holbrook, A.L., Green, M.C. and Krosnick, J.A.2003. Telephone versus Face-To-Face 248 Interviewing of National Probability Samples with Long Questionnaires: Comparisons of Respondent Satisficing and Social Desirability Response Bias. American Association for Public Opinion Research. 67, pp.79-125. Research method for business studentS saunders et al., 1997

23. Saunders, M., Lewis, P., & Thornhill, A. (2009). Research methods for business students. Pearson education.

24. Aizawa, Akiko (2003). "An information-theoretic perspective of tf–idf measures". Information Processing and Management. 39 (1): 45–65.

25. Smith, D. (2003). Environmental colouration and/or the design process. Color Research & Application: Endorsed by Inter-Society Color Council, The Colour Group (Great Britain), Canadian Society for Color, Color Science Association of Japan, Dutch Society for the Study of Color, The Swedish Colour Centre Foundation, Colour Society of Australia, Centre Français de la Couleur, 28(5), 360-365.

26. Pile, J. F. 2007. Interior Design, 4th ed. Prentice Hall

27. Attiah, D. Y., Cheung, V., Bromilow, D., & Westland, S. (2014, September). Colour planning in the interior design process. In Proceedings of The Second Conference of Asia Color Association (pp. 187-191).

28. Gage J. Color and meaning: Art, science, and symbolism. Univ of California Press; 1999.

29. Castree, N., Kitchin, R. and Rogers, A. 2013. A Oxford Dictionary of Human Geography[online]. Oxford: Oxford University Press. [Accessed 28September 2013]. Available from: http://www.oxfordreference.com/

30. Ou LC, Luo MR, Woodcock A, Wright A. A study of colour emotion and colour preference. Part I: Colour emotions for single colours. Color Research & Application. 2004 Jun;29(3):232-40.

31. Elliot, A. J., & Maier, M. A. (2007). Color and psychological functioning. Current directions in psychological science, 16(5), 250-254.