Colour Information In Design:

Understanding Colour Meaning In Packaging Design

Seahwa Won

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ABSTRACT

Colour is a powerful visual cue that affects consumer brand choice. Although there is an obvious and recognised value in the use of colour information in design, the literature demonstrates that colour information is an underexplored area that has not yet been addressed in detail by design research either practically or theoretically. Moreover, colour crosses various disciplines; due to its multi-disciplinary nature, it is not clear whether colour information is being effectively utilised in design.

The aim of this study was to identify which types of colour information are useful in packaging, and to suggest a prototype tool (at concept level) to deliver this useful colour information to design professionals. An analysis of the relevant literature revealed 13 types of colour information which were then selected as basis for the study. Subsequently, the research design consisted of two phases. The first phase was exploratory in order to gain rich insight into the characteristics of useful colour information through interviews, an online survey, a colour meaning experiment, a colour meaning framework, and a colour meaning case study. The second phase was practice-based. Based on the informed exploration from the early studies, a web-based colour tool prototype, referred to as the CMCW (colour-meaning-centred website), was created, refined, and tested.

The primary contribution of this study stems from an understanding of colour information to support design professionals; the identification of the five types (harmony, perception, meaning, psychology and printing) and the characteristics of useful colour information; and the formation of a colour-meaning framework and colour-meaning web tool. The secondary contribution of this study is the methodological approach undertaken that was used to understand the relationship between colour meaning and context by conducting a design-focused colour experiment. Research evidence highlights the importance and value of colour meaning information in design. The insight from this work will help researchers, design professionals, and colour-tool developers to make informed decisions on what they should focus on, how

they should do so, and why. This will facilitate better provisions and uptake of useful colour information for design professionals in the design process and strategy fields. The framework also could support understanding of colour design practice in an analytic way, and be employed as a research tool in various design- or marketing-related research to investigate and analyse colour.

ACKNOWLEDGEMENTS

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Chapter 1
INTRODUCTION

This chapter presents an overview of the thesis. It begins with a description of the research background and provides the study aim and objectives along with the research questions. The focus and scope of this inquiry are provided, and it concludes by outlining a brief illustration of each chapter.

1.1 Background to the research

Many areas of inquiry emphasise the significance of information (Davis, 1989; Baya *et al.*, 1992; Najjar, 1996; Shooter et al., 2000; Wodehouse & Ion, 2010; Self, 2011), as demonstrated by the phrase 'information age' (Karabeg, 2002; Van Belle & Trusler, 2005). Computer science, information systems, and engineering have largely contributed to this field of study (Nickpour, 2012). Design is an information-intensive process that includes various strategies, resources, and tools (Baya, 1996). This information is broadly termed 'design information'. It has been argued that up to 40 different types of information can be dealt with in one minute during the design process (Baya, 1996). Moreover, it is estimated that about half of the total effort in designing is spent in other works, such as information searching, planning, communication, cost estimating, reporting, helping others, and social contact (Hales, 1987). Given that a considerable range of information is sourced and used throughout the design process, it appears that the efficiency and effectiveness of the design process and its strategy rely predominantly on what information designers and brand managers have available and use.

Design information has been studied from various perspectives. For instance, Goodman-Deane *et al.* (2010) explored various aspects for developing design resources that focused on inclusive design. Lofthouse (2006) investigated the type of designers'

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requirements in regards to eco-design tools. Nickpour (2012) explored designers' information-seeking behaviour to enhance the use of people-centred information. Some previous studies have examined design information with a more specific intention to support conceptual design (Wodehouse & Ion, 2010), idea generation (Stolterman & Pierce, 2012), design decisions (Todd & Benbasat, 1992), and creativity (Johnson & Carruthers, 2006). Although colour is one of the critical design elements (Zelanski & Fisher, 1999), to date, no attempts at understanding colour as a component of information in design have been made.

Colour has acquired enormous importance in packaging and branding as a powerful visual cue (Aslam, 2006; Kauppinen-Räisänen, 2014). In the retail industry, colour (along with price) is a key differentiator for brand searching and identification, as most warehouse supermarkets more or less offer the same shopping experience through their methods of stocking and display (Aslam, 2006; Klimchuk & Krasovec, 2006). Additionally, colour is used as a communicator to convey product or brand meanings to consumers (Kauppinen-Räisänen, 2014). Thus, choosing an appropriate colour for packaging or a brand is tremendously significant for differentiating products and delivering brand messages that may affect consumer decision-making.

Colour information[1] has great potential to support designers and brand managers in the design process and strategy. However, colour is a meta-discipline that crosses diverse academic boundaries, such as science, design, art, history, and education. Due to the multi-disciplinary nature of colour, it is not clear whether colour information has been effectively utilised by users in design. A lack of use of colour information by users could result in inferior design outcomes. Moreover, existing colour knowledge derived from comprehensive (but generic) studies may have ignored the design context. A limited understanding of colour in design could lead to an unrealistic concept of design practice and strategy. These situations call attention to the need for studies of colour information

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[1] In this thesis, colour information is defined as the interpretations, abstractions, and knowledge about colour data in various fields, which include natural sciences, technology, art, psychology, history, and design. It also includes both information and knowledge in this thesis unless stated otherwise (see section 2.3.1).

in design.

The research addressed in this thesis is motivated by the fact that it is noticeable that there is currently a lack of study on colour information in design. This research, therefore, aims at investigating which type of colour information is useful in design (specifically in packaging) and what concepts a possible colour tool should adopt. It is hoped that the limited understanding of colour information in design will be improved through this study and will also be facilitated in researching and developing colour resources and tools in order to better support design professionals in the design process and strategy.

1.2 Research aim and objectives

The overall aim of this study was to identify which colour information is useful in packaging and also to suggest a tool concept to deliver the most useful colour information to design professionals.

Based on the aim of the inquiry, seven objectives are listed below:

1. To review relevant literatures and the secondary sources regarding the following:

    The contexts of a colour information study in design.

    The definition and types of colour information in the literature.

    The existing colour information tools.

    The key roles of colour in packaging and branding.

    The characteristics of design information.

    The advantages of using colour information in design process and strategy.

2. To investigate the types of (and reasons for) useful colour information in packaging .

3. To explore what colour information is used by designers and brand managers.

4. To probe designers' and brand managers' preferences and suggestions for a colour tool.

5. To explore whether colour meanings are affected by context.

6. To investigate what colour meanings are communicated in a product category.

7. To develop a concept of a colour tool.

1.3 Research questions

Initially, five research questions (RQ1-5) were formulated to address the research aim and objectives. However, the findings of interview and online survey (Chapter 4) raised additional studies focusing on colour meaning. Thus, the original five research questions were extended to the following seven research questions (including RQ4.1-4.2):

RQ1. Which colour information is useful in packaging?

RQ2. Why is a particular type of colour information useful?

RQ3. What colour information is used by designers and brand managers?

RQ4. What are designers' and brand managers' suggestions and preferences in terms of a useful colour information tool?

 RQ4.1. Are colour meanings affected by context?

 RQ4.2. What colour meanings are communicated in a product category?

RQ5. What concept should a colour information tool take to serve useful colour information?

1.4 Research scope

This research narrows the scope as follows:

Packaging. The field of design is extremely large and encompasses many industries. A PhD study does not allow adequate time and resources to engage in the total breadth of the variety of design areas. Thus, convenience, reliability, and validity are the reasons why this study restricts itself to the category of packaging.

Professional designers and brand managers. This research focuses on professional designers and brand managers as key users of colour information in a real-world design context. Brand managers are generally assumed to be higher-level employees who are in charge of selling and sales-promotional work (Armstrong & Kotler, 2015). In this thesis,

experienced individuals who are heavily involved in design strategies are broadly called brand managers. Moreover, in all further discussion, the terms 'information users', 'design professionals', and 'practitioners' will all refer to designers and brand managers.

Developing a prototype rather than focusing on technical feasibility. The intention of this study was to identify useful colour information within packaging, and to suggest a colour tool concept. Based on the findings of the research activities in this thesis, a colour-meaning-centred website (CMCW) was developed as a suitable format to deliver useful colour information to design professionals. The decision was made to create a website prototype rather than to make a fully programmed (and operational) website. This decision was reached because web programming is time consuming and requires the expensive services from a professional programmer. Thus, in this study, the final prototype outcome is presented in a non-functioning HTML coded format.

1.5 Thesis structure

This study is structured into 10 chapters.

Chapter 1: Introduction

This chapter discusses the research background and describes the research aim and objectives along with the research questions. It provides the research scope and a brief overview of each chapter.

Chapter 2: Literature Review

This chapter begins by explaining why this colour information study is necessary in design. Then, during a review of the relevant literature, the term *colour information* is defined as the interpretations, abstractions, and knowledge about colour data in various fields, which include natural sciences, technology, art, psychology, history, and design. This term is explained in detail (see Section 2.3.1). As a result, 13 types of colour information are outlined, and existing colour information tools are briefly reviewed. After that, the importance of colour is highlighted by reviewing its key role in packaging and branding. Finally, the characteristics of information used throughout the design

process, such as the client's brief, market-related information, available resources and tools, design strategy, and knowledge, are described, and the potential advantages of using colour information for designers and brand managers are discussed.

Chapter 3: Research Methodology

This chapter explains the research paradigm and the assumptions that were adopted for this enquiry, and a specific research methodology is designed. An iterative design approach is used to achieve in-depth insight of useful colour information and to develop a tool prototype based on the informed exploration. The methods of data collection and analysis used at each phase are illustrated, and at the end of the chapter, a summary of the research design is provided.

Chapter 4: Interview and Online Survey

This chapter details the interviews and online survey used in this study. It provides a clear explanation of the face-to-face interviews, online survey instruments, and data analysis methods used. Chapter 4 offers insight into the types of colour information considered important by designers and brand managers and their preferences and suggestions for a colour tool. Moreover, the findings suggest separate colour meaning studies (i.e. a colour meaning experiment, a colour meaning framework, a colour meaning case study, and creating a colour tool). These studies are detailed in Chapters 5, 6, 7, 8, and 9.

Chapter 5: Colour Meaning Experiment

This chapter illustrates an empirical colour meaning survey to explore whether colour meanings are affected by context. Prior to commencing with the experiment, a literature review is conducted for the selection and justification of the colour stimuli and bi-polar words used in the experiment. It provides insight into the relationship between colour meaning and context with a methodological implication for the future design-focused colour experiment.

Chapter 6: Colour Meaning Framework

This chapter establishes a colour meaning framework in order to provide an

understanding of what colour meanings are communicated in a product category. Practice (existing colour strategies) and semiotic theories are integrated.

Chapter 7: Colour Meaning Case Study

This chapter provides in-depth insight on colour meaning within a product category. One specific product category (washing-up liquid) is selected based on the suggestion from a brand manager of one of the leading United Kingdom (UK) consumer-goods manufacturing companies. Colours for washing-up liquid packaging are suggested using multiple methods, such as interviews, an online survey, and a colour meaning experiment. After that, one brand manager's opinion is collected regarding the developed colours and the usefulness of colour meaning information in their packaging development process.

Chapter 8: Design and Refinements 1 and 2

This chapter presents practice-based research to develop a prototype of a colour tool. Based on the informed exploration of the previous chapters, an initial prototype of a CMCW is created by the researcher. Then, the first prototype is refined based on feedback from designers and brand managers. The design outcome has the potential to become a suitable tool format to deliver useful colour information to design professionals.

Chapter 9: Expert Evaluation Survey

Expert evaluation is employed to evaluate the developed prototype and to collect additional suggestions based on the viewpoints of a panel of experts and scholars in the field of colour, graphic design, and branding. Furthermore, this chapter discusses how the developed concept would contribute positively to the design process and colour strategy, and what should be further improved.

Chapter 10: Conclusions

This last chapter provides a summary of the research findings. Insights concerning the primary findings are discussed along with the appropriateness and usefulness of the developed tool prototype. Then, this final chapter offers an illustration of the research

contributions from theoretical, methodological, and practical perspectives. Finally, the limitations of the research and the suggestions for future research are discussed.

Chapter 2
LITERATURE REVIEW

*Colour can "increase sales, increase worker productivity, reduce eyestrain
and generally affect emotional reactions" (Stanton, 1975, p.230)*

Chapter 1 provided an overview of the research motivation and scope along with the study's aim and objectives. In Chapter 2, some concepts and definitions fundamental to the inquiry are reviewed, and the significance and potential advantages of colour information in design are highlighted. Due to the novelty of the colour information study within the field of design, the background of the research is first outlined before addressing the details of what is meant by colour information in this thesis and what types of colour information currently exist.

2.1 Introduction

This chapter is organised into six sections. Section 2.1 provides an overview of this chapter. Section 2.2 discusses the context of why a colour information study is necessary in design. In Section 2.3, the literature review reveals a confusing picture for terms such as data, information, and knowledge. By analysing and synthesising conceptions of the term 'information', this thesis defines *colour information* as the interpretations, abstractions, and knowledge about colour data in various fields, which include the natural sciences, technology, art, psychology, history, and design. Moreover, based on the comprehensive literature present in colour fields, 13 types of colour information are identified, and each of the 13 definitions is outlined in this thesis. Colour tools, as a physical form of colour information, are also reviewed with a depiction of their main features, and a brief analysis is given linking with the 13 types of colour information. Section 2.4 elucidates the key role of colour within packaging and branding. Section 2.5 offers suggestions regarding how colour information can be used in the design process and in strategy reviewing the characteristics of design information; the latent benefits of utilising colour information are also discussed. Section 2.6 finishes the chapter describing the key points outlined within.

2.2 Contexts for a colour information study

The term 'design information' is not new to design (Shooter *et al.*, 2000), and a considerably large amount of information is typically used throughout the design process (Baya, 1996). After reviewing the current status of design information and colourful design trends, the need for a colour information study in design was even further emphasised.

2.2.1 The use of design information

'Design information' refers to all the information that is generated, used, referred to, consulted with, or transformed during a design process (Baya *et al.*, 1992; Shooter *et al.*, 2000). It includes multiple types, such as material and non-material resources and computational and non-computational tools (Baya, 1996). Some design information is available in explicit or formal formats, such as catalogues, material samples, handbooks, or reports (Wodehouse & Ion, 2010), while other design information is tacit, not formally documented, and formatted based upon design know-how or experience (Wong & Radcliffe, 2000). Figure 2.1 illustrates how much design information evolves during the design process. The coiled model demonstrates converse relations between design information and design space as the design shifts towards a final design. The design space indicates many alternatives at an early design stage, while the outer layer suggests that design information gets thicker as the design is detailed and its insight is achieved (Shooter *et al.*, 2000).
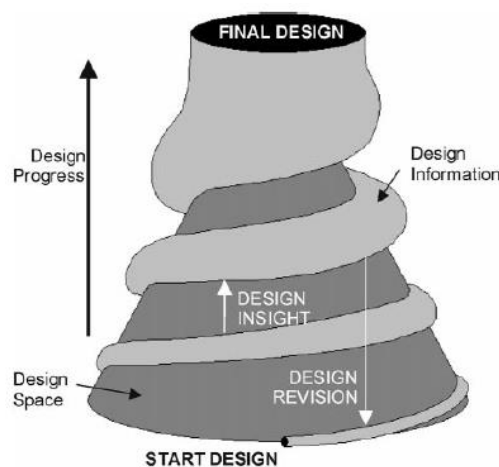
Figure 2.1 Design information development (Shooter et al., 2000)

2.2.2 Colourful design trend

Leeuwen (2011, p.9) stated that, "gradually the world would become more colourful". As an example of this trend, over the years an increasing number of products have become available to us, and many products, such as mobile phones, kitchen utensils, clothing, and pre-packed food, have become more colourful (Lightfoot & Gerstman, 1998). Figure 2.2 illustrates the colourful aisles of large supermarkets, which allow consumers to experience chromatic product displays perfectly aligned on end-caps. In such a competitive market environment, packaging plays a significant role in persuading consumers to buy the brand product (McDaniel & Baker, 1977). Although no single cue functions separately, it is argued that colour is a potent cue that helps to attract consumers' attention (Carter, 1982) and communicate product and brand meanings (Schmitt & Simonson, 1997; Garber *et al.*, 2000; Madden *et al.*, 2000). In other words, well-chosen colour may encourage consumer purchase decision-making (Ares & Deliza, 2010), grabbing consumers' attention and conveying the target messages. On the other hand, an inappropriate colour choice may lead to miscommunication with consumers and result in strategic failure (Kauppinen-Räisänen, 2014).

Yogurt

Bread

Detergent

Coffee

Figure 2.2 Colourful packaging in general large supermarkets

2.2.3 A lack of study of colour information in design

Useful information contributes to great value in design. The term 'useful' refers to the state of being beneficial for a practical purpose or a particular area (Oxford English Dictionary, 2015), and usefulness in information is a key aspect (Case, 2012). The advantages that a valuable resource can offer are not only to save duplication of effort and time during design process but also to trigger creative energies (Wodehouse & Ion, 2010). Furthermore, choice problems, such as colour, layout, and typography, may arise at every step of the design process (Sen & Yang, 1995); appropriate information can help promote a deep understanding and allow designers to make better decisions (Todd & Benbasat, 1992).

Considering the importance of colour in design and the advantages of information, it appears that it is critical to capture useful colour information for designers and brand managers. However, colour information is an underexplored area, and due to the comprehensive nature of colour, it is not clear whether colour information is effectively utilised in design. Thus, a study of colour information would be both needed and helpful to improve limited understanding of colour information in design, and to better support design professionals by providing useful colour resources and tools in a usable format.

2.3 Colour information

Through an analysis of the relevant literature, a clear conceptualisation of colour information is provided. After that, 13 types of colour information are identified as the basis of this study, and each meaning is elucidated in order to promote better understanding.

2.3.1 Definition of colour information in this study

Colour is a visual experience produced by the interaction between light, materials, and our visual system, as shown in Figure 2.3 (Kuehni, 1997). Light strikes the retina, which is the inside back wall of the eye, and is detected by rods (brightness receptors) and cones (colour receptors). When the level of light is increased or decreased, the retina moves back and forth between the rod and cone dominant areas. In bright light, we can

see more colourful objects, while in dim lighting conditions, colours are seen less clearly (Holtzschue, 2006). This process is how our visual system adapts to the quantity of the light and perceives colour.
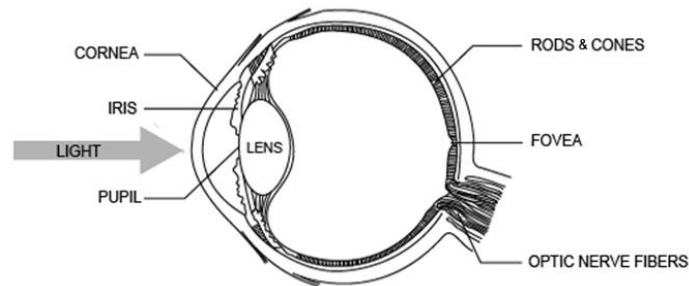
Figure 2.3 Visual system of human eyes (Holtzschue, 2006)

Before engaging with the term 'colour information', it is important to clarify the usage of the term 'information' and disambiguate it from the term 'data', as they are sometimes used interchangeably. A review of the various definitions of *data* and *information* reveals the heterogeneity of the definitions and further problematises the terms. Data can be quantitative or qualitative (Castree *et al.*, 2013). Quantitative data are numeric, and qualitative data are textual, visual, and audible, including documents, film, art, and interviews. In Table 2.1, a review of discipline-specific dictionaries was conducted to generate a consensus about the term *information*.

According to the Cambridge Dictionary of Sociology (Turner, 2006, p.291), "information may be considered on three different levels: 1) uncertainty reduction, 2) patterned abstraction, and 3) knowledge. The term connotes the recognising, creating, encoding, transmitting, decoding, and interpreting of social patterns".

In the Oxford Dictionary of Environment and Conservation (Park & Allaby, 2013), information is interpreted data which is useful for making a judgement and drawing a conclusion. According to the Concise Oxford Dictionary of Mathematics (Nicholson, 2014), information is distilled data. The Oxford Dictionary of Psychology (Colman, 2015) indicates that information is knowledge obtained by learning. In the Oxford Dictionary of Media and Communication (Chandler & Munday, 2011), information is interpreted

data which contributes to uncertainty reduction or the development of new facts.

Table 2.1 A review of discipline-specific dictionaries on the term 'information'

	Definitions of Information
The Cambridge Dictionary of Sociology (2006)	Information may be considered on three different levels: 1) uncertainty reduction, 2) patterned abstraction, and 3) knowledge. The term connotes the recognising, creating, encoding, transmitting, decoding, and interpreting of social patterns
A Dictionary of Environment and Conservation (2013)	Interpreted data which is useful for making a judgement and drawing a conclusion
The Concise Oxford Dictionary of Mathematics (2014)	Distilled data
A Dictionary of Psychology (2015)	Knowledge obtained by learning
A Dictionary of Media and Communication (2011)	Interpreted data which contributes to uncertainty reduction or new facts

In this research, the aforementioned definitions were used as a basis to formulate the following: data can be defined as observable numeric, textual, visual, and auditory properties. Raw data on their own carry no meaning. On the other hand, information is interpreted or processed data which contributes to decision-making or a reduction of uncertainty, and it also can represent new facts or knowledge acquired by learning. In an attempt to synthesise these conceptions of information, this thesis defines *colour information* as the interpretations, abstractions, and knowledge about colour data in various fields, which include natural sciences, technology, art, psychology, history, and design.

There are many dynamic factors that shape the visual elements of packaging and branding (Calver, 2004; Klimchuk & Krasovec, 2006). It can be safely argued that, packaging and branding do not follow one ideal method of creating products. Brand owners, strategists, and marketers will all use different approaches in the creation of packaging and branding, while different design agencies might use various approaches

to creative realisation. For example, Elmwood[2], an influential UK brand consultancy, stated that it uses its own design strategy named 'step change'. Pearlfisher[3], a UK packaging design agency, mentioned that its design strategy focuses on change. Thus, this research will explore which types of colour information and knowledge are useful for designers and brand managers in packaging and branding. Based on this insight, the concept of a colour tool will be suggested.

2.3.2 Types of colour information in the literature

As reviewed in Section 2.3.1, colour information refers to interpretations, abstractions, and knowledge regarding colour data in various fields, such as natural sciences, technology, art, psychology, history, and design. However, colour information is a relatively unexplored area that has not yet been practically or theoretically studied in detail by design research. For this reason, it is problematic to identify which types of colour information are explicitly recognising, transmitting and interpreting. Therefore, this section reviews the diverse interpretations on colour which have been studied by psychologists, designers, and cognitive scientists in various academic fields. This review is essential in order to holistically understand various types of colour information.

To explore which types of colour information have been significantly examined in academic fields, 229 journals (Appendix A1) and 10 academic books (Appendix A2) on colour were investigated using title analysis. The title of a document offers a compressed summary of what it contains (Senda & Sinohara, 2002), and title analysis provides insight into what topics are currently interesting in a relevant filed (Ruben, 1992). The title terms presented in the 229 journals and the 10 books were counted using an online word frequency counting site while excluding grammar words, such as 'of' or 'the'. Subsequently, specific topics and terminologies that have been primarily used within the colour field were explored. Table 2.2 provides a rank-ordered listing of title terms appearing in 229 journals searched using the keyword 'colour' in Colour Research and Application (CRA), which is a primary journal of the colour field for 2011-

2014. Table 2.3 provides another rank-ordered listing of book titles, chapter titles, and section title terms mentioned in 10 academic colour references which can be generally sourced in any university library.

Table 2.2 Frequencies of article title terms of 229 CRA journals

Title term	Frequency	Title term	Frequency	Title term	Frequency	Title term	Frequency
color, colour(s)	198	part	8	model	6	space	4
based	19	between	8	cielab	5	composition	4
hue(s)	17	two	8	emotion	5	cross	4
appearance	15	constancy	8	lightness	5	study	4
effect	13	data	8	new	5	factor	4
harmony	13	comparison	7	surface	5	paper	4
method	12	adaptation	7	fabrics	5	achromatic	4
difference	12	rendering	7	differences	5	computational	4
evaluation	11	methods	7	estimation	5	natural	4
different	11	effects	7	gamut	5	influence	4
chromatic	10	quality	7	**light**	5	correction	4
vision	10	determination	7	skin	5	human	4
images	9	**printed**	6	visual	5	optimization	4
spectral	9	experimental	6	red	5	assessment	4
preference(s)	9	reflectance	6	perceived	5	models	4
analysis	9	**perception**	6	display	5	terms	4
system	8	spectra	6	architecture	4	laws	4
measurement	8	unique	6	digital	4	wavelength	4
munsell	8	image	6	measuring	4	formulae	4

*Terms occurring four or more times are presented in descending order of frequency

Table 2.3 Frequencies of book title, chapter title, and section title terms of 10 colour reference books in the University of Leeds's library

Title term	Frequency	Title term	Frequency	Title term	Frequency	Title term	Frequency
color, colour(s)	359	**history**	10	goethe	6	natural	5
hue(s)	46	relation	10	cie	6	painting	5
introduction	30	simultaneous	9	subtractive	6	glass	5
design	27	**perception**	9	compositions	6	century	5
light	27	wheel	9	different	6	computer	5
harmony	22	black	9	illusion	6	advice	5
value	22	vision	9	fashion	6	system	5
theory(-ies)	20	**trends**	9	future	6	appearance	5
references	19	dyeing	9	**naming**	6	communication	5
hue	18	**psychology**	8	fibres	6	science	5
conclusions	18	pigments	8	change	6	classicism	5
gradations	18	dyes	8	lines	6	high	5
effects	17	white	8	family	6	patterns	5
chroma	16	forecasting	8	warm	5	mode	5
information	16	objects	7	media	5	planes	5
sources	16	process	7	systems	5	unrelated	5
art(s)	16	ancient	7	pigment	5	spatial	4
red	15	principles	7	munsell	5	how	4
further	15	space	7	dimension	5	**preference**	4
contrast	14	early	7	order	5	eye	4
complementary	12	medieval	7	depth	5	culture	4

mixing	12	scheme	7	chromatic	5	optical	4
printing	11	effect	6	**symbolism**	5	world	4
blue	11	subjective	6	language	5	newton	4
yellow	10	saturation	6	human	5	runge	4

Terms occurring four or more times are presented in descending order of frequency

In the CRA journal, titles predominantly focus on 'harmony', 'preference', 'measurement', 'printing', 'perception', and 'light'.

In the 10 colour references, titles and contents frequently concern *design, light, harmony, theory, art, printing, history, perception, trend, psychology, naming, symbolism, and preference.*

After analysing these terms, 13 conclusive types of colour information were identified and are listed below in alphabetic order:

- Colour in art and design
- Colour harmony
- Colour history
- Colour and light
- Colour meaning
- Colour measurement
- Colour notation
- Colour perception
- Colour preference
- Colour printing
- Colour psychology
- Colour theory
- Colour trend

Of course, the list is not intended to be definitive or exhaustive. For example, there is no obvious rationale for restricting this survey to hard-copy books or journals and excluding internet sources and it is impossible to argue that the literature used for this study was exhaustive. Nevertheless, these terms for colour information provide a

holistic overview of the current topics and relative interest in the colour field. This preliminary analysis offers at least some indication of the different aspects of colour using constituents of colour information that are widely available. All terms used in the list of the colour information are the same terms that appear in the reviewed journals and books except for two terms: colour meaning and colour notation. The original terms listed in Table 2.4 were *symbolism* and *naming* instead of *meaning* and *notation*. However, colour meaning and symbolism tend to be used as synonyms, and it has been recognised that colour notation is easier to understand than naming.

2.3.3 Understanding the 13 colour information terms

The following sections investigate a variety of existing concepts around the 13 types of colour information. However, some of these 13 types of colour information have no commonly agreed definitions, and boundaries between the types are blurred at times. For instance, colour harmony, meaning, perception, preference, and psychology denote various overlapping concepts rather than explicitly distinct ideas. Their many definitions make it difficult to compare and accumulate any findings (Kollat *et al.*, 1970), and differentiating each concept can provide better understanding of its meaning. Thus, the following sections provide descriptions of what the 13 types of information indicate, and these are used in the studies described later in this thesis.

2.3.3.1 Colour in art and design

Colour has been of great interest in art and design over at least the last five centuries (Osborne, 2012). A review of the existing academic colour books largely includes various ways and examples of colour application in well-known paintings or design work (Riley, 1995; Gage, 1999; Zelanski & Fisher, 1999; Feisner, 2006; Osborne, 2012); for example, how early people used colours or how famous designers and brands applied colours to their products and/or advertisements.

2.3.3.2 Colour harmony

Colour harmony has a wide range of meanings, and there is no universally agreed definition for this concept. Ou and Luo (2006) suggested two different approaches to

colour harmony after reviewing early studies. One method suggests that colours can harmonise when they are similar in hue, lightness, or chroma (Chevreul, 1967; Goethe, 2006). Another is that colours can harmonise when they are chosen within a colour wheel or an ordered colour space (Itten, 1961; Ostwald, 1969; Munsell, 1969). Judd and Wyszecki (1963) defined colour harmony as the colour combinations that produce a pleasing response. Burchett (2002) provided a similar concept of colour harmony. This notion of colour harmony has been accepted in various disciplines, such as art and design (Westland *et al.*, 2007), architecture (O'Connor, 2009), and colour science (Ou and Luo, 2006). This definition has a strong connection between harmony and a pleasant response to colour.

2.3.3.3 Colour history

Osborne (2012) stated that history includes past instances that in retrospect are considered especially significant. Many academic colour references tend to delineate the chronological development of colour in painting, fashion, and dyeing. Feisner (2006) considered the characteristics of colour in paintings and fashion design in Egyptian, Greek, and Roman cultures as well as during the Middle Ages, the Renaissance, and the Baroque and Modern world. Abel (2012) illustrated a descriptive history of dyes and pigments and described how specific pigments, such as purple, have been developed from prehistoric times until the present. Furthermore, Blaszczyk (2012) depicted how colourful phenomena evolved, introducing the stories of relevant practitioners and industries that have made modern dyes and pigments possible. Reflection of the current references suggests that colour history is concerned with how specific colours or pigments in certain periods were developed.

2.3.3.4 Colour and light

Light is the carriage of energy in the form of electromagnetic waves that make things visible to humans (Hanson, 2012). Light can be described by its wavelength, and the wavelengths to which humans are sensitive are those between 360 and 780 nm (Westland *et al.*, 2007). Our understanding of the concept of light and colour was greatly influenced by Isaac Newton's (1643-1727) discovery that when white light passes

through a prism, the seven colours of red, orange, yellow, green, blue, indigo, and violet are separated, as shown in Figure 2.4.
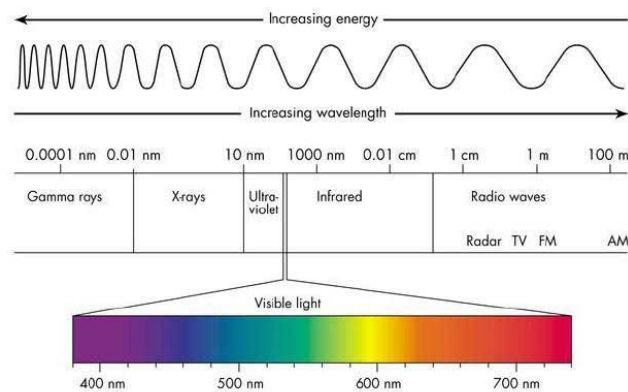
Figure 2.4 Spectral colours (Holtzschue, 2006)

2.3.3.5 Colour meaning

The term 'meaning' refers to the mental response to stimuli (Osgood *et al.*, 1957). Colour meaning is not about finding colour combinations that create pleasing responses (colour harmony), not about the processes with which people understand and react to colour (colour perception or psychology), and not about liking a particular colour among alternatives (colour preference). Instead, it is concerned with the meanings that are associated with certain colours. A detailed explanation of colour meaning is addressed in Chapter 6.

2.3.3.6 Colour measurement

The act of measuring colour is related to quantifying colour. The specification of colours enables us to define colours and communicate about them in a reliable and reproducible manner (Goodman, 2012). Various colour instruments are currently available, and they can be generally classified as tristimulus colorimeters, spectroradiometers, and spectrophotometers (Zwinkels, 1996). An international system for colour measurement exists, and it is known as the CIE system (Commission Internationale de l'Éclairage). The application of this system to quantify colours can be applied to many industries, such as the food, packaging, or consumption environments (Hutching, 2012). For example, this system enables car body repair using the original paint colours.

2.3.3.7 Colour notation

The term 'notation' refers to written indications by a set of signs (Oxford English Dictionary, 2015). In order to describe colours and communicate about them, colour notation systems, such as Munsell, the Natural Colour System (NCS), or Pantone, are commonly used (Setchell, 2012). The Munsell colour system, which is one of the most widely adopted ways of communicating colours, was developed by Albert Munsell (Zelanski & Fisher, 1999) who created *The Atlas of the Munsell Color System* in 1915. The modern form of the system is based on three colour dimensions: hue, value, and choma. The NCS was developed by the Scandinavian Colour Institute and is a similar system based on three pairs of opposing colours: white-black, red-green, and yellow-blue; this system is usually used for matching colours. Moreover, Pantone is another type of colour system that also enables designers or manufacturers in different locations to match colours without direct contact.

2.3.3.8 Colour perception

The term 'perception' is related to the process through which human senses, such as seeing and hearing, become aware of and understand physical objects or phenomena (Oxford English Dictionary, 2015). The study of how people perceive colour is complex. Neuroscientists have focused on the responses of eye receptors (and/or the brain) to understand how people see and react to colour (Webster, 1996; Zeki, 1999). Psychologists are interested in subjective thinking or beliefs concerning specific colours (Grieve, 1991; Hurlbert & Ling, 2012) or visual searching (Eriksen, 1952; Farmer & Taylor, 1980; Carter, 1982). In product-related research, colour perception is strongly concerned with how it draws consumers' attention (Imram, 1999).

2.3.3.9 Colour preference

Colour preference is concerned with which colours individuals prefer among alternatives (Mikellides, 2012). Empirical research into colour preference is more than 100 years old (Hurlbert & Ling, 2012). One of the earliest experiments to study people's preference for colour was conducted by Dorcus (1926) who found that yellow is less popular among females than with males. Guilford and Smith (1959) presented a similar

result to that of Dorcus (1926), indicating a lesser preference for yellow and a greater preference for blue and green colours among both genders. Eysneck (1941) attempted to produce a universal order of preference (blue, red, green, purple, orange and yellow). Smets (1982) found that more saturated colours are generally preferred. More recently, Mikellides (2012) analysed previous studies in an attempt to produce a general conclusion for colour preference and reported that blue is the most popular colour for both males and females, whereas yellow is the least popular; red and green were a close second for the favourites, and violet is more popular to females. However, Mikellides highlighted that colour preferences vary between individuals and can change depending on marketing, cultural context, and age.

2.3.3.10 Colour printing

The quality of printing in photography, graphic designs, or advertisements is of great significance as it is related to creative expression and commercial design outcomes. Relevant literature of colour printing has wholly or partially dealt with the development of printing techniques (Parraman, 2012). Over the last half century, the quality of colour printing has improved from the early laborious and time-consuming printing process it once was. There are many techniques for producing images in colour, and they enable modern mass reproduction of colour, such as publishing newspapers and magazines (Kipphan, 2001). Four-colour printing technology is a commonly used but more sophisticated reproduction of colour using six or eight colours of ink rather than four can also be found (Zelanski & Fisher, 1999).

2.3.3.11 Colour psychology

'Psychology' is the study of the human mind and behaviour (Oxford English Dictionary, 2015). According to O'Connor (2009, p.230), colour psychology is defined as "affective, cognitive and behavioural responses and associations linked to specific colours". Psychologists have a broad interest in colour, such as the innate, perceived, emotional, and learned reactions to a coloured object (Crozier, 1996). There is a clear potential overlap between the terms colour psychology and colour meaning. Although there are intersections and subsets between other colour terms, the definition given by O'Conner

was considered appropriate for this study.

2.3.3.12 Colour theory

Colour theory refers to systematic frameworks and rules that have been established to explain what colour is both scientifically and psychologically (Feisner, 2006); it forms the basis for the curricula of many higher education colour courses in art and design. Isaac Newton attempted to separate coloured light (by passing it through a prism) into its component colours and claimed that there are seven representative hues. Moses Harris maintained that there was a multitude of colours in his book, *The Natural System of Colors* (1766). He presented three primary colours (red, yellow, and blue) and suggested that other colours can be created by mixing these three basic ones (Feisner, 2006). Furthermore, other colour observations were made by Goethe in *Theory of Colors* (1810) and Chevreul in *The Principles of Harmony and Contrast of Colors* (1854). Subsequently, systematic and artistic colour theories were also introduced by Albert Munsell, Wilhelm Oswald, and Johannes Itten. In the early 20th century, industrial attempts had expanded to produce CMYK or Pantone codes.
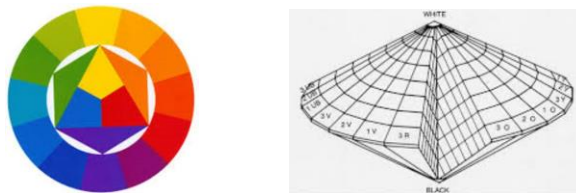
Figure 2.5 Itten's colour wheel (left) and Ostwald's colour model (right)

2.3.3.13 Colour trend

The word 'trend' is defined as a general indication that something is changing (Oxford English Dictionary, 2015). Hidefi (2012) stated that a colour trend refers to changes that a particular colour for a product or material is expected to take or has taken in a certain period of time. Many factors, such as environment, social events, and technology, can influence colour trends. For example, global warming can have a critical influence on colour trends; eco-friendly design, eco-materials, or eco-colours are all important trends. Global events, such as the World Cup, can have a tremendous effect on short-term colour trends where specific uniform colours could appear in fashion and accessories.

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Furthermore, the development of technology, including new materials and chemicals, can influence colour trends. Colour trend researchers analyse and interpret why particular colours are used and are popular, and their insights are used in various fields, such as design, marketing, and paint manufacture (Hidefi, 2012).

2.3.4 Definitions of the 13 types of colour information in this study

As previously mentioned, five concepts (harmony, meaning, perception, preference, and psychology) from among the 13 types of colour information show overlapping modality. In particular, colour perception and psychology cover many broadly similar concepts. It has been recognised that it is important to more clearly distinguish these five terms as they will be used later in the thesis. Thus, based on commonalities found in the relevant literature and considering the focus on design in this thesis, Table 2.4 details the definitions for the terms that will be used in the remainder of this thesis.

Table 2.4 Definitions of the 13 types of colour information used in this study (*Alphabetic order)

Colour in art and design: Colours in well-known paintings or design works
Colour harmony: Colour combinations which arouse a pleasing effect
Colour history: How a particular colour was developed
Colour and light: Principles of light, such as wavelengths and frequencies
Colour meaning: Colour meanings associated with certain colours
Colour measurement: Measuring the properties of colour or using colour measurement devices
Colour notation: Colour numbers or names to describe or communicate colour
Colour perception: How colour draws people's attention
Colour preference: People's favourite colours
Colour printing: The quality and techniques of colour printing
Colour psychology: Affective, cognitive, and behavioural responses linked to specific colours
Colour theory: Systematic frameworks and rules intended to explain colour
Colour trend: Colours which are on-trend or popular

2.3.5 Colour information tool

Information can have a physical form (Case, 2012). In general, a tool refers to a device

that can fulfil certain functions and that is usually operated with the hands (Oxford English Dictionary, 2015). If theoretical and conceptual tools, such as questionnaires or mind mapping, are included in addition to material artefacts under the notion of a tool, the range of tools may be almost limitless. Thus, this thesis defines tools as those having physical and observable formats, such as a book or website. After reviewing the colour tool formats, an analytic view of the tools linked with the 13 types of colour information is briefly provided.

2.3.5.1 Digital and non-digital tools

A colour information tool could involve items such as websites, software, mobile apps, books, etc. These tools can be described as being either digital or non-digital tools.

• Digital tools

Digital tools refer to a device that is related to the use of computer technology (Oxford English Dictionary, 2015). Modern digital techniques have made it possible to access an extensive range of information resources, especially over the internet. Tables 2.5, 2.6, 2.7, and 2.8 provide the main features of digital tools from the perspective of sourcing colour information.

Table 2.5 Portal site

Portal site
- Description: A portal is a system that is designed to provide real-time information to web users. A web search engine operates by running a web crawler, which is responsible for collecting URLs, hyperlinks, and tags from the web (Sherman, 2005).
- Data type: Raw, processed, textual, and visual
- Advantage: Easy accessibility and current, up-to-date information
- Disadvantage: Comprehensive
- Examples

Google is one of the most famous web portals that allows people to collect diverse sources and ideas. There are two ways in searching for colour resources. By general searching, any images or data by keywords can be searched. By advanced searching, images associated with certain colours can be foraged.

General searching
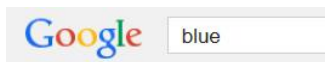
Advanced image searching

Searched images

Table 2.6 Website

Website
- Description: A website includes web pages on a single or several related topics, and usually maintained by one person or organisation.
- Data type: Raw, processed, textual, and visual
- Advantage: Easy accessibility, specific topics, and functions
- Disadvantage: Sometimes less reliable, and mostly focused on colour scheme generators
- Examples

Adobe Kuler (kuler.adobe.com)
User-centred colour scheme generator
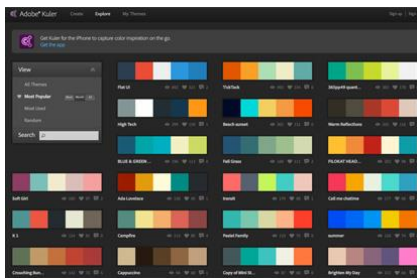
Colour lovers (www.colourlovers.com)
Community-driven website to discuss colour
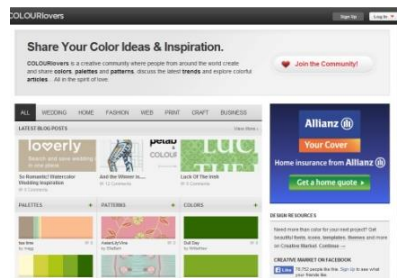
Pantone (http://www.pantone.com)
Colour trend report and Pantone tools

Colour explorer (www.colorexplorer.com)
Colour libraries, colour matching, etc.
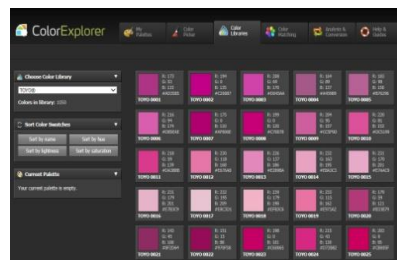
Tin eye (labs.tineye.com/multicolr)
Free images from Flickr by selected colours

Colorotate (web.colorotate.org)
Colour scheme generator with 3D

Table 2.7 Software

Software
- Description: Computer software is often in the form of a computer program that performs specific functions.
- Data type: Visual
- Advantage: Right level of detail for the topic and function
- Disadvantage: Not always free, needs to be installed on laptop, and is mostly focused on colour scheme generator
- Examples
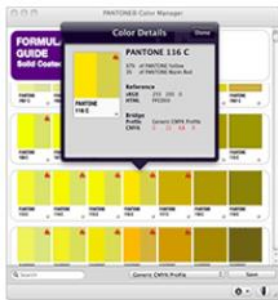
Pantone colour manager
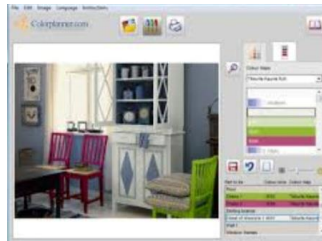
Colour planner
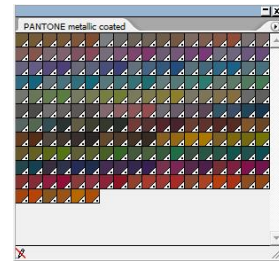
Illustrator CS 6
(Partly provided)

Table 2.8 Mobile app

Mobile app
- Description: A mobile app is software for mobile devices (usually smartphones or tablets).
- Data type: Visual
- Advantage: Easy accessibility, visual, current and up-to-date information, and portable
- Disadvantage: Not always free, and typically used for fun
- Examples
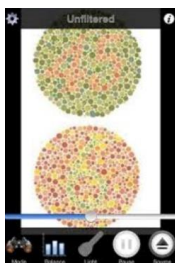
Colour blind test
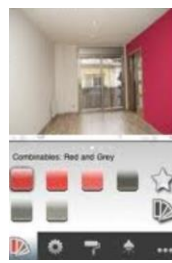
Colour change

Colour capture

• Non-digital tools

A non-digital tool has nothing to do with the internet or electronic things. This involves publications and colour matching cards. Tables 2.9 and 2.10 provide the main features of the non-digital colour tools.

Table 2.9 Publications

Publication
- Description: Academic books or journals on colour
- Data type: Mainly textual
- Advantage: Right level of detail and reliable
- Disadvantage: Textual and paid   Mainly descriptive (text-based) whereas general design books are visual, as shown below   General colour academic references (left) and general design books (right)

Table 2.10 Colour matching systems

Colour matching system
- Description: A colour matching system is a physical tool that allows designers to colour-match specific colours. The Pantone Matching System (PMS), the Natural Colour System (NCS), and the Munsell Colour System have been widely adopted by designers.
- Data type: Mainly visual
- Advantage: Right level of detail and reliable
- Disadvantage: Paid, and discolouration over time
- Examples   Pantone   NCS

2.3.5.2 Colour tools and the 13 types of colour information

This study provides a summary of the existing colour tools associated with the 13 types of colour information. Table 2.11 was aimed to present a succinct reflection rather than an exhaustive one.

Table 2.11 Existing colour tools and the 13 types of colour information

		Website	Software	Mobile app	Publication	Colour matching system
Colour information	Colour in art and design	+	-	-	+	-
	Colour harmony	+	+	+	+	-
	Colour history	+	-	-	+	-
	Colour and light	+	-	-	+	-
	Colour meaning	+	-	-	+	-
	Colour measurement	+	-	-	+	-
	Colour notation	+	+	+	+	+
	Colour perception	+	-	-	+	-
	Colour preference	+	-	-	+	-
	Colour printing	+	-	-	+	-
	Colour psychology	+	-	-	+	-
	Colour theory	+	-	-	+	-
	Colour trend	+	-	-	+	-
Features	Advantage	Easy accessibility	Right level of detail	Easy accessibility	Right level of detail, reliable	Right level of detail, reliable
	Disadvantage	Sometimes less reliable	Low accessibility (paid)	Sometimes less reliable, paid	Low accessibility (paid)	Dis-colouration over time, paid
	Data type	Textual and visual	Mainly visual	Mainly visual	Mainly textual	Mainly visual

*Note: + tool provides - tool does not provide

As shown in the table, a website provides users with hundreds of pages of both textual and visual colour information that may almost accommodate all 13 types of colour information. There is a big advantage in using websites because accessing can be free. However, as a tool, websites are quite eclectic and therefore less reliable sources for seeking out essential information to apply to the design process and strategy. Current colour related software, which is another digital tool, is mostly concerned with supplying functions that find harmonious-looking colours in interior design and

providing information on colour notation (e.g. Pantone codes). Although this software offers a detailed and relatively reliable level of colour information, the disadvantage of it is that it is sometimes not easy to access due to its expensive cost or the technical process required to install it on a laptop. A mobile app is software for mobile devices, and these apps have become more and more commonplace items, providing the advantages of being both handy and visual. However, a majority of the mobile applications offers limited colour information (e.g. changing the colour of personal photographs or Pantone codes), are principally used for fun, and sometimes have costs associated with accessing them. On the other hand, non-digital tools, such as books or journals, provide reliable colour sources in a mainly descriptive form that are based on research with a depth and breadth regarding the 13 types of colour information. However, many studies have found that designers prefer visual data for inspiration and creative ideas. Colour matching systems are a commonly used tool that allows for colours to be communicated without any direct contact between users. Pantone, NCS, and Munsell have been widely adopted in a variety of industries.

Each tool has pros and cons. In order to establish more appropriate and effective value in information, it has been suggested that the information should be relevant (Sperber & Wilson, 1986), accessible (Fidel & Green, 2004), and presented in a suitable format (Case, 2012). Thus, if a colour tool were developed based upon an understanding of which type of colour information is most useful for design professionals and what tool format is suitable for their way of working, design professionals could be better supported.

2.4 Colour in packaging and branding

This section reviews the key role of colour, and emphasises the significance of colour within packaging and branding.

2.4.1 Relationship between colour, packaging, and branding

The significance of packaging is increasing in competitive markets as it acts like a silent salesman on the shelf (Silayoi & Speece, 2004; Carol, 2002). It is claimed that 73% of

purchase decisions are made at the same place where consumers actually buy a product (Rettie & Brewer, 2000). Moreover, it is argued that in-store stimuli, such as packaging, can increase the probability of an unintended purchase by up to 93% (Inman *et al.*, 2009). These facts have brought the visual aspects of packaging to our attention as these aspects interact with consumers while they evaluate a product in a shop (Morgan, 1997). In other words, packaging design has become critical for product and brand communication at the point of sale (Pantin-Sohier, 2009). Thus, packaging is now no longer simply a method used to protect a product, but also plays a role as an active sales tool that stimulates consumer brand choice (Calver, 2004). Packaging and branding are closely related because a brand label generally appears on a product's packaging (Stanton, 1975).

Branding has been used for centuries to distinguish individual goods from one another (Room, 1998). There is a plethora of definitions of the term 'brand'. According to Armstrong and Kotler (2015, p.237), a brand is "a name, term, sign, symbol, or design, or a combination of theses that identifies the maker or seller of a product or service". Best (2010) stated that a brand might refer to a company as a whole or to the company's individual products and services. De Chernatony and Riley (1998, p.418) provided 12 aspects in terms of defining the term brand: "a legal instrument, a logo, a company, a shorthand, a risk reducer, an identity system, an image in consumer's mind, a value system, a personality, a relationship, a value adding device, and an evolving entity". In view of the above definitions, all goods, services, and corporations can be branded, and a brand includes both visible and invisible elements. To achieve a more competitive advantage in today's market, companies invest heavily in the visual elements of brands, such as logos, symbol, packaging, and environment in which the brands appear (Lightfoot & Gerstman, 1998).

While acknowledging the importance of visual factors, such as the colour, shape, size, or material consisting of a packaging and a brand at the point of purchase is significant (Schmitt & Simonson, 1997; Bloch *et al.*, 2003), it is also crucial to grasp how they influence consumers' choice (Kauppinen-Räisänen, 2014). It is reported that 80% of our brain is committed to responding to visual stimuli (Lightfoot & Gerstman, 1998). In

particular, it is argued that colour has a dominant influence on the willingness of consumers to purchase a product (Grossman & Wisenblit, 1999; Ares & Deliza, 2010). No single cues exist in isolation; rather, they are all closely related. However, prior theoretical and empirical evidence provides a compelling argument that colour is one of the most powerful visual cues in packaging and branding, as it largely contributes to consumers' attention and brand communication (Schmitt & Simonson, 1997; Kauppinen-Räisänen, 2014). Figure 2.6 shows the close relationship between colour, packaging, and branding. This finding also indicates that colour is a critical issue for both designers and brand managers, as they are colour decision-makers in the development and planning of packaging and branding (Stanton, 1975).
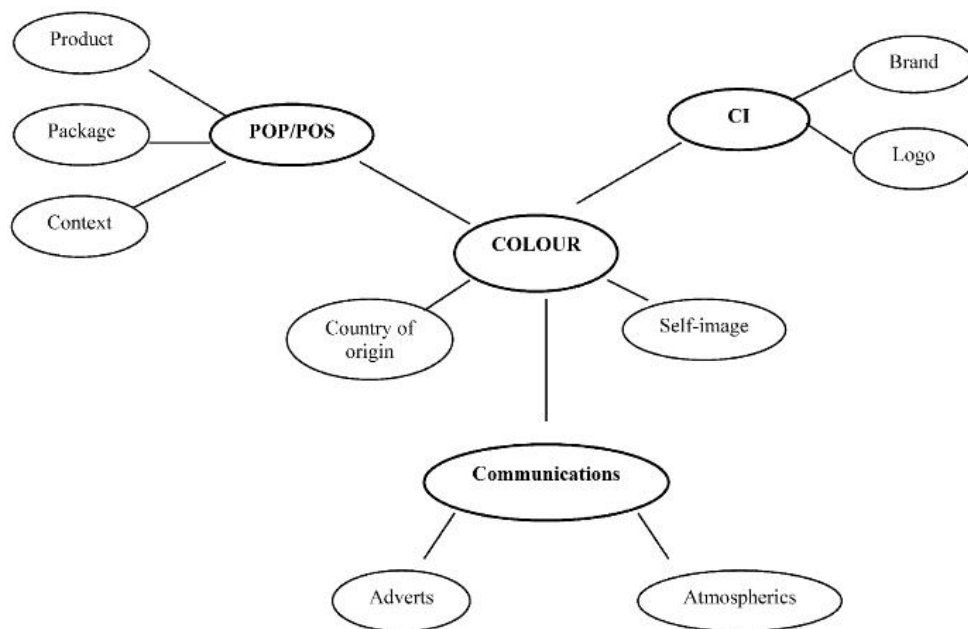
Figure 2.6 Interactive relationships between colour, packaging, and branding (Aslam, 2006)

*Acronyms: CI (Corporate Image), POP (Point of Purchase), and POS (Point of Sale)

2.4.2 The key role of colour

As stressed previously, colour is a significant visual cue that influences consumers' choice, grabbing their attention and conveying meanings. The next sections provide details regarding how colour may help to draw attention and to convey brand messages.

2.4.2.1 Colour attracts attention

Attention refers to the state of taking notice of something (Oxford English Dictionary, 2015). In order to influence consumers at the point of purchase, the product must stand out and hold consumers' attention in a cluttered, colourful, and competitive market environment (Kauppinen-Räisänen & Luomala, 2010). It also is emphasised that colour is efficient for capturing attention and allowing people to find an object quickly (Carter, 1982). Eriksen (1952) investigated response times as participants searched for objects that had four different visual dimensions of form, hue, size, and brightness. The results showed that visual attention for the colour could be highly significant. Zeki (1999) measured responses of different brain areas in terms of visual elements, such as colour, motion, and form. The results provided orderly evidence that when people see an object, colour is the first recognised element, followed by its form and movement.

In relation to packaging colour, Kauppinen-Räisänen (2014) suggested that consumers' attention can be drawn either voluntarily or involuntarily. Voluntary attention is related to consumers' memory when familiar colours are used. In such cases, consumers use colours to search for and identify brands based on the colours stored in their memory. Hamwi and Landis (1955) found that memory for colour is relatively stable and accurate. In their study, participants were asked to give a name to a coloured chip and, after a delay, they were asked to select the same chip from among chips of other colours. The results indicated that the participants could remember the colours no matter the delay time, which ranged from 15 minutes to 65 hours. In a study on colour and memory, Tavassoli (2011) found that colour has a strong impact on brand name memory. Macklin (1996) claimed that colour can help children better remember brand names. A more recent study by Kimura *et al.* (2013) argued that the degree of remembering colours is significant for familiar objects. On the other hand, involuntary attention is aroused by the surprise effect of encountering a novel or unexpected colour (Kauppinen-Räisänen & Luomala, 2010). Geke (2008) reported that distinguishing a product from others provides a benefit that draws consumers' interest by breaking the expectation based on their memory of actual experiences. These prior studies confirm the importance of colour in packaging and branding as a powerful visual cue for capturing attention which may lead to consumers' choice.

2.4.2.2 Colour communicates meanings

Colour communicates product meanings. Having succeeded in drawing attention, product and brand meanings therefore interact with consumers (Kauppinen-Räisänen, 2014). Specifically, colour conveys messages concerning products' attributes, such as quality and flavour. In regards to the product quality, in the United Kingdom (UK) and Taiwan, red, blue, black, and purple are perceived as expensive or high-quality colours, whereas green is believed to represent inexpensive products (Grimes & Doole, 1998). Another study from the UK reported that white is perceived as low quality, while beige is perceived as expensive; pink represents an average price (Kerfoot *et al.*, 2003). Moreover, a transparent product is often perceived as being of a low quality (Aslam, 2006). Packaging colour has been recognised as an important element in consumers' food choices, often reflecting their expectations with regard to flavours (Hutchings, 2012). For example, Piqueras-Fiszman and Spence's experiment (2012) found that orange and dark cream-coloured cups enhance one's perception of a chocolate's flavour. Apart from food flavour, packaging colour also reflects consumer expectations of the food texture, and yellow packaging colour of dessert products are perceived as creamy and soft desserts (Ares & Deliza, 2010).

Colour conveys brand and corporate meanings. Brand meanings are related to consumers' perception for a brand, which is often called the 'brand image' (Campbell, 1998). These meanings are formed based upon what consumers associate with a brand (Nandan, 2005), and they influence brand evaluation and choice (Keller, 1993). For example, McDonald's simple and strong colours are perceived as dynamic and energetic, whereas Laura Ashley's delicate colours are thought to be elegant (Aslam, 2006). Moreover, some brands' colours allow consumers to recall specific brands spontaneously: for instance, Campbell's red and Progresso's blue (Schmitt & Simonson, 1997). Furthermore, colour assists in the establishment and maintenance of a company's corporate image (Hynes, 2009). For example, green often stands for reliable and secure and is used for organisations, such as those in the financial and higher education sector (Caivano & Lopez, 2007).

2.5 Colour information support

Given the existence of the broad range of colour information and the significant role of colour in packaging and branding, it is therefore accepted that colour information is a component of the information used in the design process. In this section, characteristics of diverse design information are reviewed, including how colour information could be used by design professionals. After that, the advantages of using colour information in the design process and strategy are discussed.

2.5.1 Colour information in the design process and strategy

As mentioned previously, the design process involves various strategies, resources, and tools (Baya, 1996). Although design processes tend to be different from one organisation to another and even between different design teams (Shooter *et al.*, 2000), Table 2.12 provides one example of the information generated and sourced in various stages of the design process (Wodehouse & Ion, 2010). Multiple and mixed natures, including material and non-material or computational and non-computational, are evident in the use of information.

Table 2.12 Information and the design process (Wodehouse & Ion, 2010)

Design stage	Information generated	Information sourced
Planning	Briefing documents, project plan, general communications	Market data, company reports
Concept Development	Brainstorming notes, sketches, rough calculations, meeting notes	Competitor products, past design schemes
System-level Design	Sketches, drawings, rough mock-ups, cost evaluation, meeting notes	Textbooks, suppliers' data, catalogues
Testing and refinement	Experimental data, manufacturing drawings, bills of materials, test specifications, assembly methods	Standards, databases
Production ramp-up	Sales presentations, photographs, demonstrations, presentations graphics, product instructions	Customer feedback, retail data

2.5.1.1 Client-provided information

Clients are a key information provider in design (Goodman-Deane *et al.*, 2010), and a design is traditionally initiated with the briefing material offered by a client (Lawson, 1997). This material can include organisational aspirations, initiatives, the target audience, deadlines, the project, or the task (Best, 2010). Within the brief, a more specific design brief could be involved (Hales & Gooch, 2004). Morgan (1997) illustrated the typically included elements for a design brief: product type, packaging type (card, paper, box, can, bottle, sealed plastic, vacuum formed, or other), weight, material, brand information (logo, colours, or typefaces), market information (age range, gender, or country), competing products, and advertising style (medium, campaign length, and budget). However, the brief by the client is frequently provided in an unclear and incomplete manner, as many clients are less experienced at preparing design briefs (Lawson, 1997; Goodman-Deane *et al.*, 2010). Best (2010) suggested that design professionals should use the client's brief as a basis to understand what the client want to achieve and to recreate the brief in a way that can offer new possibilities or approaches. Hence, when design professionals face a design task that requires colour to be considered, colour information that promotes creative and strategic thinking in regard to the client's problem can be useful.

2.5.1.2 Market information

Market information is concerned with the resources provided for understanding what customers want and need (Ottum & Moore, 1997). These resources (e.g. Mintel reports) typically involve statistics and trends of target markets with the presentation of numbers, charts, and tables. However, Cooper (1975) argued that insufficient market-related resources are collected, and a lack of understanding of market leads to product failure. Moreover, in the use of information within the design field, there is a commonly accepted suggestion that designers prefer to access visual material rather than textual formats regardless of whether they are creating tangible or intangible objects (Lofthouse, 2006). Alternative market information could be provided that focuses on colour in order to better understand consumer's colour choices (e.g. colour meanings perceived by consumers in different culture or age groups). Moreover, this information

may be more useful for design professionals when it is produced in a way that is well suited to design work approaches: more visual and less quantifiable.

2.5.1.3 Available resources and design tools

Diverse information during the design process is often sourced from the internet, books, personal experiences, users, and experts (Goodman-Deane *et al.*, 2010). With the development of the internet, nearly unlimited information is available, and new design tools are constantly being designed and introduced. Stolterman et al. (2009) described the different kinds of tools used during the design process, as shown in Table 2.13. They categorised the design tool types with a more comprehensive perspective under the headings of physical tools, software tools, theoretical tools, and others. Although this study's description of tools includes physical and observable formats, such as books or websites, it is worth a review of how various tools may be considered during the design process. The types and features of the existing colour tools were previously reviewed in Section 2.3.5.

Table 2.13 A list of design tools (Stolterman et al., 2009)

Physical tools	Software tools	Theoretical tools	...and others
Pen paper	Acrobat Reader	Mind mapping	Verbal
pencil	Website	Ethnography	Face to face
Whiteboard	Adobe Photoshop	Questionnaires	Mouth
Markers	Microsoft PowerPoint	Film theory	Mind
Eraser	Adobe Fireworks	Personal experience	Hand
Big pad of	Axure RP	Facts	gestures
paper	Adobe Flash	Surfing for ideas	Thoughts
Sheets of printer	Secondlife	Literature review	Prior
paper	Adobe Illustrator	Stories	knowledge
Color marker	Adobe Indesign	Books	Eyes
Post-it notes	Digital software	Magazines	Ears
Tangible stuff	Wireframes	Carrols method of	Teammates
Audio recorder	TechSmith Morae	scenarios	
Video recorder	Camtasia	Hazbolts method of	
Digital camera	CSS HTML	affinity diagramming	
Foam core	Microsoft Excel	Heuristics from	
Pair of scissors	Microsoft Word	Nielson/Norman	
	Visio	Activity theory	

Survey monkey.com WordPress software tools Online repositories Google images Blogs Random word generator	Ideas of external cognition Contextual enquiry Usability guidelines (frameworks including aesthetics, functionality, mediation, breakdown, symbolism, usefulness)	

2.5.1.4 Design strategies

Creating sustainable and competitive advantage is a critical issue in any business (Olson *et al.*, 1998), and in order to achieve this end, various design strategies are used (Geke et al., 2008). The word 'strategy' derives from the Greek *strategos*, which means military commander or general. Andrews (1980) explained that a strategy is a plan for achieving a specific goal. García (2012) argued that as the origin of the word 'strategy' portrays, design decision-makers should have a holistic view like a military commander to avoid biases and incorrect assumptions. Olson *et al.* (1998, p.55) provided a more clear definition of design strategy as the "effective allocation and coordination of design resources and activities to accomplish a firm's objectives". This definition indicates that a design strategy requires input from a wide range of information in order to create saleable products and successful brands. In this sense, it appears that the effectiveness of a design strategy largely relies on what information is used by design professionals. The right level of and a well-researched amount of colour information that supports current colour strategies (which are reviewed in Section 6.2) can be helpful for design professionals.

2.5.1.5 Design knowledge

Design research and design knowledge. According to Manzini (2009, p.5), "*design research* is an activity that aims to produce knowledge useful to those who design: *design knowledge* that designers and non-designers (individuals, communities, institutions, companies) can use in their processes of designing and co-designing". In this sense, it can be argued that the nature and quality of design knowledge is closely

related to academic design research. In terms of the types of design research, Frayling's three classifications (1993) is one of the most commonly used concepts in design research (Friedman, 2008). The three types are 'research into design', 'research through design' and 'research for design'. *Research into design* refers to theoretical research documenting material, structure and history of design. *Research through design* is related to actual design practice. Finally, *research for design* aims to help and guide design practice. While Fraying's interpretation of design research provides broad perspective covering all design possibilities (Yee, 2010), Cross (1999) proposed three taxonomies based on the focus of design research. The three categories (Cross, 1999, p. 6) are: 1) design epistemology – study of designerly ways of knowing; 2) design praxiology – study of the practices and processes of design; and 3) design phenomenology – study of the form and configuration of artefacts. Design epistemology is related to people; design praxiology is process and phenomenology is product (Yee, 2010). Although design research has been conducted at various angles in order to understand and help design practice, designers generally criticise design knowledge created by academic research (Tan, 2012). The main reason for the disagreement between academia and practice could be due to a different focus about what is significant in design practice (Nickpour, 2012). For designers the design outcomes are critical issue rather than the process which academia typically has been interested in. Dorst (1997) claimed that "design researchers have paid insufficient attention to the experience of designing and that by improving our knowledge of this phenomenon a more compete account of design activities would be achieved. If design researchers can develop a more comprehensive account of design activities it will contribute to bridging the gap between design theory and design practice (Spencer, 2008, p.2)".

Translating academic research to practical usable knowledge for designers. In order to bridge the gap between research and practice, one of the most discussed concerns in design research is the importance of capturing designers' tacit knowledge such as know-how (Tan, 2012). Wong and Radcliffe (2000) argued that design knowledge is largely tacit depending on personal experience or intuition. Tacit knowledge is related to intuition, know-how based on practice, and personal experience; it is not stored and implied. On the other hand, explicit knowledge refers to academic knowledge that is

formally documented, reusable, systematic and sharable, and described in formal language, print, or electronic media (Smith, 2001). In addition, Cross (1982) claimed that designers have their own 'designerly ways of knowing' in collecting information and solving the design problem. Heskett (2002) wrote that design is a process of layering where "new developments are added over time to what already exists" (p.6-7). Tan (2012) explained layering as a novel research method that creates design knowledge by accommodating 'designerly' approaches. Acknowledging the tacit nature of design knowledge and existence of designerly approaches, it is significant and challenging to capture useful knowledge based on designers' experience.

There have been many attempts in various design fields in order to capture and understand designerly knowledge and ways to create useful design knowledge for designers. Schon's (1983) concept of the 'reflective practitioner' shows a good example of investigation on how design professionals think in action i.e. designerly ways of knowing. One of his key case studies was observing students' reflective conversation under the supervision of design professionals in architectural designing, and proposed the phrase 'reflection-in-action' to explain how practitioners think on the construction of the design issue and the solutions. Spencer (2008) conducted interviews with eight expert designers to explore their experiences during the design process. The key finding was that professional designers faced ambiguity, fear and uncertainty when they figured out design solutions. In order to escape from the emotional disquiet, creative thinking was used iteratively. Tan (2012) explored how designers referred to knowledge and how it was built up by interviewing designers participated in seven design projects. Seven designers' roles were identified: co-creator; researcher; facilitator; capability builder; social entrepreneur; provocateur and strategist. In order to bridge the gap between academia and practice, Tan also suggested five aspects in design research: 1) shaping a vocabulary of design methodology that speaks to what designers do, while also recognising where they draw inspiration; 2) discovering new insights and knowledge that is relevant to design practitioners; 3) exploring how 'know-how'; 4) exploring how designers articulate their value, beyond descriptions of the design process, in the early stages of a project to clients and stakeholders; and 5) re-engaging designers with academic design research.

What past studies have neglected. Despite the importance of colour in design and a variety of design information available, colour often tends to be regarded as a secondary element in design theoretically and practically (Leeuwen, 2011); thus research on colour information is neglected. In addition, the scope of colour research is comprehensive ranging from neuro-science to packaging design, and much knowledge derives from those conducted in scientific methods rather than taking into account design context. For instance, in the majority of contemporary colour research, colour samples are used isolated from the context applied to objects. This could generate knowledge disjoined design, and could deliver inappropriate colour knowledge to designers as well as design students (as they are educated based on those past colour research). Here again, the importance and needs of careful attention to the study of colour information in design research is reiterated.

2.5.2 Advantages of utilising colour information

A review of the design information provides an understanding of possible places and alternative ways of colour information in the design process and how these could affect colour information considerations. This review suggests that colour information has many opportunities that can be utilised as a component of creative and strategic design sources. However, despite the importance of colour in design and a variety of design information available, the use of colour information may be neglected; colour often tends to be regarded as a secondary element in the design process (Leeuwen, 2011). This section discusses the potential value of using colour information and accentuates the significance of better provisions and uptake of colour information by users. The advantages of colour information can be exemplified in the following three points.

First, colour information can make a design process more efficient. The process of packaging and branding is a time- and effort-consuming procedure. It is argued that valuable resources can save time and reduce the amount of effort required to complete a task (Wodehouse & Ion, 2010). Thus, better provision of colour information to designers and brand managers can improve their design process.

Second, colour information can help designers and brand managers make better colour

decisions, as they typically face various choice problems, such as colour, layout, and typography, throughout the design process (Sen & Yang, 1995). Although choosing the right colour is of tremendous importance, it is never easy. Certain colours come and go according to product categories (Lightfoot & Gerstman, 1998). Today, pink is popular, but tomorrow this could change. Case (2012) emphasised the use of information that helps compare and decide various choices. Thus, information can help designers make better and more confident decisions (Paese & Sniezek, 1991; Todd & Benbasat, 1992).

Third, colour information has the potential to assist in the development of colour strategies. As reviewed in Section 2.4, the effect of colour on packaging and branding is significant. Colour meanings are strongly shaped in consumers' minds, and careful discretion is vital when selecting or changing colours. Although colour cannot overcome an ill-conceived strategy, it appears that there are appropriate or inappropriate colours in design. However, when time-strapped, colour choice in design may be determined by relying on the briefing materials from clients or designers' personal intuitions. This method can be limited since it is difficult to determine which colour attracts consumers' attention and conveys which meanings to consumers depending on the designers' intuition. Thus, colour information that is linked with certain product categories or various target audiences can be beneficial in order to meet consumers' expectations while evaluating the brand and achieving more competitive advantages using appropriate colours. For example, consider one design team that consists of marketers, designers, engineers, etc. If the team receives a brief to design a brand for elderly people in Korea, and none of them belongs to the user group, then, how will the design team make an appropriate colour choice? Good use and better provision of colour information can help design professionals to better understand a consumer's choice.

2.6 Conclusions

The aim of this chapter was to build up an understanding of colour information in design. This literature review has covered three key topics (i.e. colour information, importance of colour, and colour information support). Packaging and branding were also a focus of this research.

A clear conceptualisation of colour information was provided to define the term *colour information* and to identify 13 types of colour information in the literature. Colour information in this thesis is defined as interpretations, abstractions, and knowledge about colour data in various fields, such as natural science, history, and design, etc. The identified types of the 13 colour information types are colour in art and design, harmony, history, light, meaning, measurement, notation, perception, preference, printing, psychology, theory, and trend. The features of available colour tools were also reviewed, as were the physical forms of colour information. The advantages and disadvantages of website, software, mobile app, publication, and colour matching systems as representative tool types were outlined, and a brief analysis of the tools that associated them with the 13 types of colour information was also given. Generally, website and publication cover all 13 colour information types, while software, mobile apps, and colour matching systems offer relatively limited information.

In terms of the significance of colour in consumer choice, prior studies have focused on either attention-related or communication-related choices. The first category of studies examines the impact of colour in drawing consumers' attention. The second group of studies investigates the effect of colour in conveying product, brand, and corporate meanings. The key role of colour and its competitive benefits that enable it to increase consumer choice consolidate the importance of colour in design.

The design process is an information-intensive process that employs a variety of strategies, resources, and tools. Although diverse information is provided by a client, a marketing team, or obtained through self-searching, at times this information is insufficient or less reliable and does not fully align with design professionals' needs. Moreover, there is a high possibility that colour information could be neglected since design work predominantly relies on designers' intuition and colour has tended to be treated as only one component of many design elements. In this sense, colour information has the potential to offer beneficial aids in the design process and strategy. Considering these factors, this chapter shed light on the need of a colour information study in design and the opportunity that can be facilitated for better provisions and uptake of colour information in the design process and strategy.

Chapter 3
RESEARCH METHODOLOGY

"Colour is an important but little-understood specialty within the design professions"

(Blaszczyk, 2012, p.xiii)

Chapter 2 emphasised the need of a colour information study for the better provision of useful colour information to designers and brand managers. Thus, the research focused on exploring the characteristics of useful colour information itself and developing a tool prototype to deliver this information to design professionals. This chapter outlines the methodological approaches and describes the planned procedures and methods selected for conducting the study.

3.1. Introduction

The selection of an appropriate methodology and research design is essential in any research (Robson, 2011). Methodology encompasses both the philosophical assumptions and the methods applied to the study (Duberley *et al.*, 2012). Blaikie (2000) stated that the research design is a plan related to data collection and analysis to address research aims and objectives and also suggested core elements to consider in the research design stage. Several of these elements are used to structure this chapter: *research paradigm*, *purpose*, *strategy*, *methods used for data collection*, and *data analysis*.

This chapter consists of the following sections. Section 3.1 provides a brief summary of the chapter. Section 3.2 outlines the research paradigm that entails the theoretical underpinning behind the research methodology. Section 3.3 presents the research purpose and explains what types of knowledge this study is concerned with. Section 3.4 describes the research strategy that was used to address the research questions in this thesis. Section 3.5 outlines the research design and describes the specific methods used for data collection, analysis, and sampling. This study adopts an iterative design approach to achieve in-depth insight regarding useful colour information and to apply rich input to design output. Section 3.6 discusses the quality of the research. Finally,

section 3.7 provides an overview of the research design.

3.2. Research paradigm

A research paradigm is a choice for informing and guiding inquiry (Guba & Lincoln, 1994). The paradigm includes a set of assumptions related to what is the nature of reality (ontology) and how it can be known (epistemology). Research paradigms range from the positivist approach to the interpretive approach (Cooper & Schindler, 2008). Prior to discussing the theoretical underpinning of this thesis, four types of research paradigms are reviewed that describe the two core characteristics (ontology and epistemology) embedded in the paradigms. Then, the selection of the paradigm for this study is discussed. Table 3.1 summaries the four types of paradigms.

Table 3.1 Research paradigms (Guba & Lincoln, 1994, p.109)

	Positivism	Post-positivism	Critical theory	Constructivism
ONTOLOGY	Naïve realism: 'Real' reality but apprehendable	Critical realism: 'Real' reality but only imperfectly and probabilistically apprehendable	Historical realism: Virtual reality shaped by social, political, cultural, economic, ethnic and gender values; crystallised over time	Relativism: Local and specific constructed and co-constructed realities
EPISTEMOLOGY	Dualist/objectivist; findings true	Modified dualist/ objectivist; critical tradition/community; findings probably true	Transactional/ subjectivist; value-mediated findings	Transactional/ subjectivist; created findings

Positivism entails an ontological assumption that reality is a true status that exists objectively and independently (Guba & Lincoln, 1994). The research aim is to produce generalisable knowledge by observing the reality objectively and excluding any subjective dimensions. Post-positivism is the view that reality is assumed to exist but can never be perfectly comprehensible. Proponents of this view claim that it is impossible to accurately observe the ultimate reality due to imperfections inherent in

human senses. This stance attempts to test the temporarily accepted theory by collecting appropriate data in order to get as close as possible to the reality (Blaikie, 2007). Critical theory shares the view that reality is based on social, political, or cultural forces. This approach aims not only to describe the nature of social life but also to suggest what needs to be done to change the situation (Blaikie, 2000). Constructivism is strongly related to interpretivism, and the two are regarded as similar notions (Schwandt, 1994). This view is ontologically based on subjective meanings that are created both socially and experientially; a researcher and a subject are linked interactively to understand meaningful social actions and experiences (Blaikie, 2007).

Duberley *et al.* (2012) stated that it is difficult to fit a study to one particular philosophical stance. However, selecting the research philosophy is critical as it guides the approach used by investigators to find answers to the research questions (Guba & Lincoln, 1994). In this thesis, a constructivist approach is predominantly adopted because the research largely relies on designers' and brand managers' subjective experiences and opinions on colour information. Moreover, based upon participants' suggestions, the prototype of a colour information tool is to be cooperatively and iteratively developed by the researcher as a designer. To put it concisely, the nature of this research is based on the participants' subjective input, and the knowledge was co-created by the researcher and the participants. In this sense, it was recognised that it would be difficult to find only one objective reality using objective or scientific methods in the same manner as the positivism and post-positivism approaches do. Thus, a constructivist approach was mainly adopted for this research.

3.3 Research purpose

The purpose of this research is concerned with which types of knowledge are to be produced (Blaikie, 2000). Research purposes can be classified as exploration, description, explanation, or prediction (Blaikie, 2000). Table 3.2 summarises the four research purposes.

Table 3.2 Classification of the purposes of enquiry (Blaikie, 2000)

	Description
Exploration	- Finds out what is happening when very little is known about the topic being investigated - Seeks new insights - Generates ideas and hypotheses - Adopts flexible methods
Description	- Attempts to find out what it is happening or in what way - Illustrates accurate account for some phenomenon, characteristics or attitude towards an issues - Requires previous knowledge so that narrowly defined focus can be investigated
Explanation	- Identifies causes of events or regularities and provides causal explanation - Establishes the elements, factors or mechanisms to explain why particular regularities occur
Prediction	- Finds out what is likely to happen in the future - Requires the use of previous knowledge to postulate certain conditions

The research topic of colour information in design has not been practically or theoretically investigated in detail by design research and never has been examined within a packaging and branding context. This research does not intend to build or test a theory but instead to produce new insight regarding colour information in design and to generate ideas for a colour tool concept. Therefore, this research is mainly exploratory in nature.

3.4 Research strategy

A research strategy provides logic to answer research questions (Blaikie, 2000). There are four types of research strategies: inductive, deductive, retroductive, and abductive. These strategies provide different ways of answering research questions. Table 3.3 contains summaries of the four research strategies.

Table 3.3 Research strategies (Blaikie, 2000)

	Description
Inductive	- Aims to establish universal generalisations to be used as pattern explanations - Pursues the following steps: accumulating observations or data, producing generalisation, and using these laws as patterns to explain further observations
Deductive	- Aims to test theories to eliminate false ones and corroborate the survivor - Includes the following steps: constructing a theory, deducing hypotheses, and testing the hypotheses by matching them with data
Retroductive	- Aims to discover underlying mechanisms to explain observed regularities - Pursues the following steps: modelling a regularity, constructing a hypothetical model of a mechanism, and finding the real mechanism by observation
Abductive	- Aims to describe and understand social life in terms of social actors' motives and accounts - Pursues the following steps: discovering everyday lay meanings, producing a technical account from lay accounts and developing a theory

An inductive strategy is a common-sense view of how scientists establish general laws (Blaikie, 2000). It begins with objective observations or measurements to collect data. By applying inductive logic, some generalisations are produced to describe the order in reality. A deductive strategy is known as a hypothetic-deductive method (Blaikie, 2000). It starts with constructing a tentative theory. Then hypotheses are generated and tested by matching collected data. A retroductive strategy commences with checking existing knowledge to explore whether generative mechanisms exist. A hypothetical model is established with the assumption that it does exist, and then observations or experiments are conducted to test whether the structure exists. An abductive strategy refers to the process of inventing a hypothesis (Gold *et al.*, 2010). Central to this logic is identifying subjective patterns experienced and interpreted by people. It commences by exploring everyday concepts or meanings that social actors use. Following this initial explorative phase, conjecture is used to determine a set of initial hypotheses, and a particular hypothesis is chosen to investigate further. Then, a model is abducted to accommodate the hypotheses (Blaikie, 2000).

This research predominantly employed an abductive approach. However, inductive and deductive approaches were combined with the main approach. The chosen research strategies provided answers for the seven research questions (RQ) of this study:

RQ1. Which colour information is useful in packaging?

RQ2. Why is a particular type of colour information useful?

RQ3. What colour information is used by designers and brand managers?

RQ4. What are designers' and brand managers' suggestions and preferences in terms of a useful colour information tool?

    RQ4.1. Are colour meanings affected by context?

    RQ4.2. What colour meanings are communicated in a product category?

RQ5. What concept should a colour information tool take to serve useful colour information?

An abductive strategy can answer both types of 'what' and 'why' questions to facilitate further understanding of the subjective meanings used by people and the activities in which people engage (Blaikie, 2007). This form of reasoning has been used in many different disciplines, such as social science, design, education, human resources, and business, when the research is connected with practice (Tomiyama *et al.*, 2003; Kolko, 2010; Gold et al., 2010) or the relationship between a researcher and participants are linked rather than isolated (Dubois & Gadde, 1999; Visconti, 2010). This research explored the insider view of colour information perceived and experienced by designers and brand managers. In doing so, the subjective patterns on the types and formats of useful and preferred colour information were investigated (Chapter 4). Based upon a reasonable assumption and informed exploration, a prototype of a colour tool was developed (Chapter 8). As mentioned previously, one major point of the abductive approach is to generate plausible hypotheses rather than theory so that it can be replaced when more promising ones are proposed (Thomas, 2010; Gold *et al.*, 2010). In fact, this point was intertwined for this thesis. Thus, it was recognised that an abductive approach was appropriate for this colour information study to build insight for useful colour information itself and ideas to undertake a practice-based project for colour tool concept development. However, the research uses more than only an abductive

approach. Blaike (2000) suggested employing different strategies for individual research questions to achieve the best procedure in acquiring the answers. Thus, an inductive approach was employed in the literature analysis stage to investigate 13 types of colour information (Chapter 2). The deductive approach was adopted in an online survey to support interview findings (Chapters 4 and 7), in an e-mail survey (Chapter 8) to gain more understanding of the developed colour tool prototype, and in an expert evaluation survey (Chapter 9) to test the hypothetical tool concept and collecting experts' opinions. Also, when choosing a more plausible hypothesis (Svennevig, 2001), it was recognised that additional colour meaning studies needed to be included. The first was to test whether colour meanings are affected by context (Chapter 5), and the second was to explore what colour meanings are communicated in a product category (Chapters 6 and 7). Consequently, the adopted strategies would be able to expand understanding of both in-depth insight and empirical phenomena by playing a supplementary role and providing more comprehensive evidence (Blaikie, 2000).

3.5 Research design

The research design is an integrated statement of the methods selected in planning any type of research (Blaikie, 2000). The term 'method' is used here to refer to specific techniques of data collection (Robson, 2011). The current study attempted to examine which type of colour information is most useful in packaging and to suggest a tool (or concept) to deliver this information to design professionals in an optimal manner. Thus, for this purpose, the research design contains two phases. The first phase included the exploratory stage, which was employed to obtain more insights about the characteristics of useful colour information through interviews, online surveys, a colour meaning experiment, a colour meaning framework, and a colour meaning case study. The second phase presented the practice-based phase, in which the researcher as a designer practically carries out the design task of developing a prototype of a colour tool and subsequently gaining feedback from designers and brand managers.

A specific research methodology was designed based on the aims and objectives of this colour information study. An iterative design approach is adopted to achieve in-depth

insight of useful colour information and also to develop a tool prototype based on this informed exploration. Although there are several iterative design models or methodologies, the proposed preliminary designs that are central to the iterative approach are repeatedly revised based on the results of analysis (Baecker *et al.*, 1993; Kelley, 1994; Evbuomwan et al., 1996; Maciaszek, 2001). Ramollari and Dranidis (2007) suggested the iterative development model by Larman (2005) as a commonly used method for digital tool or system development. Thus, this study adopted Larman's (2005) iterative model for the overall structure in designing a methodology. The main process of the model relies on analysis, design, implementation, and evaluation, as shown Figure 3.1. The analysis specifies the design requirements; design and implementation are enacted for designing, coding, and programming, while an evaluation can be conducted using a formal review (Maciaszek, 2001; Bannan-Ritland, 2003). Moreover, an iterative design approach can accommodate flexible and multiple methods (Alfonso & Botía, 2005). Therefore, as the research proceeded, different research methods were applied in separate research phases to meet each research objective.
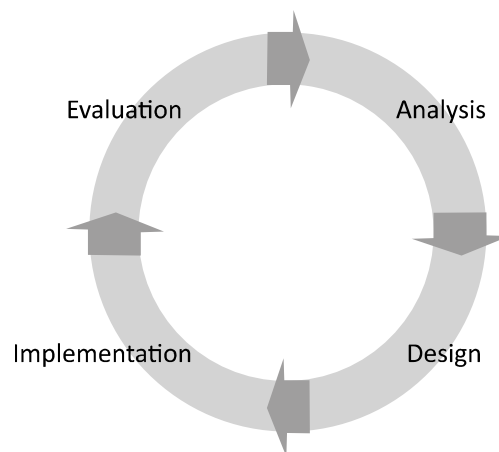
Figure 3.1 Larman's (2005) iterative development model

Because it adopted an iterative design approach, this study begins with analysis, followed by design and evaluation. It is important to note that this research is not intended to be a technical realisation of a colour tool due to the relatively short space of time that a PhD allows. Instead, it is meant to focus on an in-depth exploratory investigation of the characteristics of the types of useful colour information in packaging

and branding. Thus, in the tool development stage, the final design outcome would be produced in the form of an HTML-coded website that does not actually function. Thus, the implementation stage (programming a website) is not included in this study. Figure 3.2 presents the schematic research methodology adopted by this thesis.
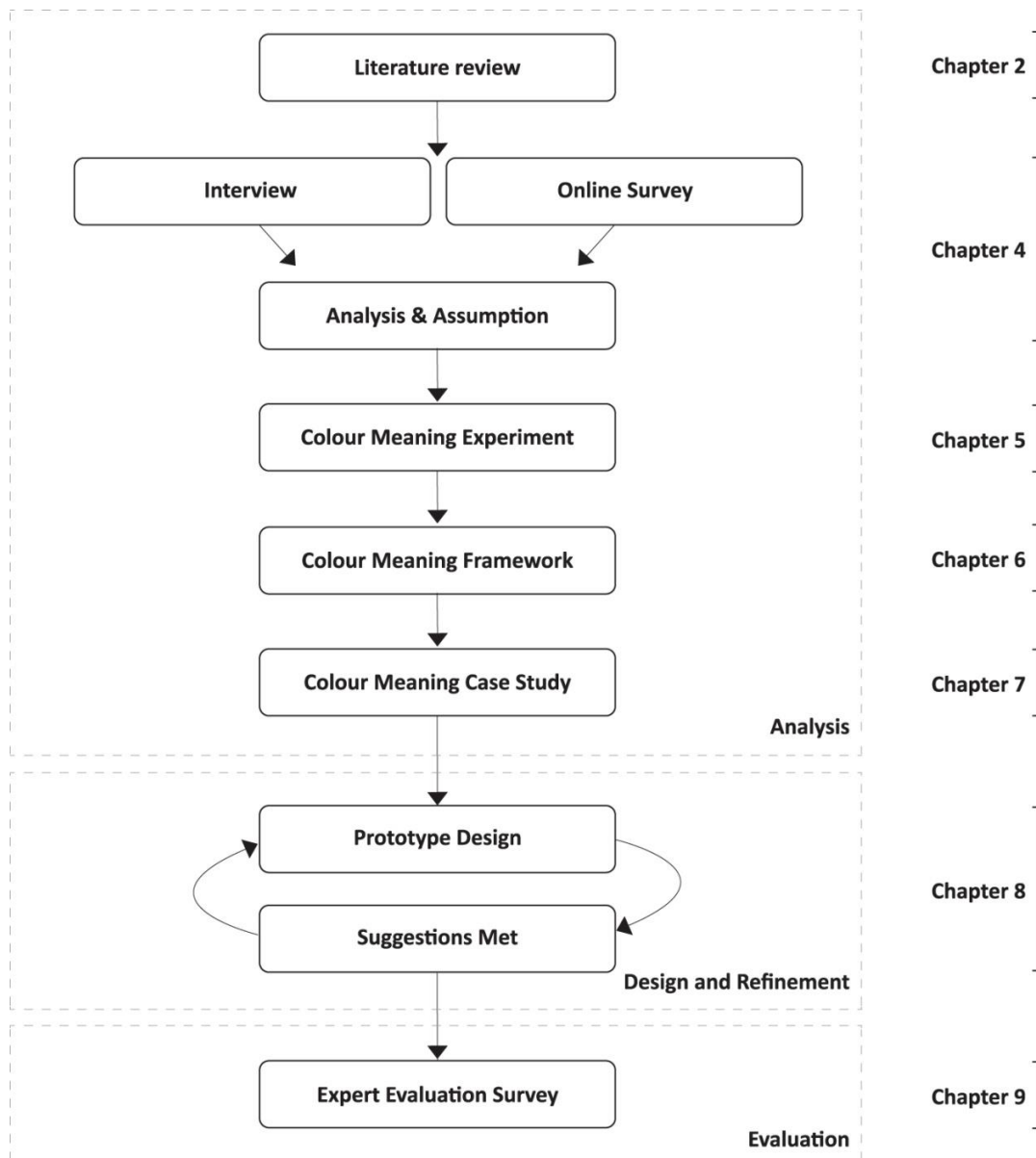
Figure 3.2 Research design in this study adapted from Larman's (2005) model

Literature review. Due to the scarce knowledge on colour information in design, it was difficult to start with any criteria for studying colour information inquiry. Therefore, the research began with an analysis of the relevant literature, and the 13 types of colour

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information were pre-conceived as preliminary work; specifically, these 13 types were colour in art and design, harmony, history, light, meaning, measurement, notation, perception, preference, printing, psychology, theory, and trend.

Interview. The objectives of the interviews were as follows: a) to investigate the types and the reasons why particular types of colour information are useful for designers and brand managers; b) to explore how colour information is used by designers and brand managers; and c) to investigate designers' and brand managers' preferences and suggestions for a colour tool. Designers and brand managers were asked to choose useful colour information from among the 13 pre-conceived types of colour information, and rich data regarding their selections were collected.

Online survey. The survey was designed to support the interview findings in regards to the types of useful colour information in packaging and branding.

Analysis and Assumption. An analysis of the interview and online survey results provided in-depth insight of colour information in design and served as a starting point for capturing the concept of a colour information tool. The drawn assumption for a colour tool was a colour-meaning-centred website (CMCW). Moreover, the results from the interview and online survey also generated two research questions (RQ4.1 and RQ4.2) concerning colour meaning. Thus, in order to address these questions, three colour meaning studies (a colour meaning experiment, a colour meaning framework, and a case study) were included.

Colour meaning experiment. An empirical colour survey was conducted to investigate the relationship between colour meaning and context (i.e., product categories). The results of the experiment played a significant role and were embedded in the CMCW prototype development stage.

Colour meaning framework: With the integration of practice (existing colour strategies) and semiotic theories, a colour meaning framework was established to provide an understanding of which colour meanings are communicated in a product category.

Colour meaning case study. A case study was carried out in order to gain detailed insight on colour meaning in a product category. Washing-up liquid was chosen for the focus based on the suggestion from a brand manager of one of the leading consumer goods manufacturing companies. This study explored what elements are important when consumers buy a washing-up liquid product and investigated colours for the product packaging. After the study was conducted, the brand manager's opinion for the developed colours and the usefulness of colour meaning information in their packaging development process were collected.

CMCW prototype design and refinement. The generated assumption from the analysis of the interview, online survey, colour meaning experiment, colour meaning framework and colour meaning case study were transformed into a design brief to develop an initial CMCW prototype. Based on the design brief, an initial colour website prototype was designed and created by the researcher using general design methods, such as brainstorming, sketching, wireframing,[4] and prototyping. Once the initial prototype was completed, the prototype was refined twice based on feedback from the participants. Each refinement study included its own evaluation, analysis, and design phase in order to refine the previous prototype. The final prototype was produced as a non-functioning HTML prototype.

Evaluation. In order to evaluate the developed HTML prototype and to gain additional suggestions, an expert evaluation survey was carried out with colour, graphic design, and branding experts.

3.5.1 Data collection

Table 3.4 includes a brief description of the methods used for the data collection. The details and limitations of each method used are discussed in detail in the relevant chapters that employed them.

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[4] Wireframes indicate where various elements will appear on a site using lines and boxes (Jonathan et al., 2008).

Table 3.4 Data collection methods used for this study

Methods used	
Interview (Chapter 4)	Senior designers and brand managers (N=10) in London were interviewed in person.
Online survey (Chapter 4)	Designers, brand managers, and researchers (N=62) identified through LinkedIn with a strong interest in packaging and branding rated the importance of the 13 pre-conceived types of colour information.
Colour meaning experiment (Chapter 5)	Participants (N=25) rated a total of 54 images (6 sets of colour chips and 6 sets of objects) against five bi-polar words.
Colour meaning case study (Chapter 7)	Participants (N=10) were interviewed in person. For the online survey, participants (N=74) were recruited. For the colour experiment, participants (N=25) rated a total of 19 images against four bi-polar words. One brand manager in a UK company was interviewed in person.
E-mail survey and follow-up interview (Chapter8)	The same interviewees who had taken part in the previous interviews were contacted, and 8 participants out of the 10 agreed to provide feedback for the CMCW prototype development.
Expert evaluation survey (Chapter 9)	Eight experts (One senior manager in Pantone and seven academics in colour, graphic design, and branding areas) evaluated the developed colour tool prototype.

3.5.2 Data type

Qualitative research is concerned with collecting and analysing data in many forms, chiefly non-numeric data. On the other hand, quantitative research produces findings that have been recorded numerically by statistical procedures (Strauss & Corbin, 1998). To address the research aims and objectives, both qualitative and quantitative data were collected.

3.5.3 Data analysis

For qualitative data, a template approach was used for coding and clustering the data (King, 2012). For the quantitative data analysis, descriptive and inferential analysis was employed. Specifically, the one-way analysis of variance (ANOVA), R-squared, and paired-sample t-test were employed to explore measures of central tendency and

relationships between various variables. The procedures for analysing the data are described in detail in the relevant chapters. Table 3.5 displays the data analysis methods used for this study and a brief description of their purposes.

Table 3.5 Data analysis methods used for this study and their purposes

Methods used	Purposes
Template analysis (Chapters 4, 7, 8, and 9)	To analyse qualitative data from interviews, e-mail surveys, e-mail interviews, and expert evaluation surveys.
Descriptive statistics (Chapters 4, 5, 7, 8, and 9)	To determine the types of and reasons for useful colour information. To identify the most preferred tool and data type. To determine the suggestions of a colour tool. To explore whether colour is affected by context. To determine what elements are important when consumers buy a washing-up liquid product. To investigate which green colour best describe expensive-inexpensive, effective-ineffective, safe-unsafe, and eco-friendly-non-eco-friendly. To determine whether participants' suggestions have been met for the CMCW. To explore experts' viewpoints of the CMCW.
One-way ANOVA (Chapter 4)	To identify whether there were significant differences between the 13 types of colour information and the three participant groups.
R-squared (Chapters 4, 5, and 7)	To examine whether there were relationships in regards to the use of colour information between the results of the interviews and the online surveys. To identify any relationship between colour chips and context-applied colours. To examine whether a relationship existed between the results of the interviews and the online surveys amongst the important elements for a washing-up liquid product.
Paired-sample t-test (Chapter 5)	To examine whether there were significant differences between colour chips and the context-applied colours.

3.5.4 Sampling

In the interviews (Chapter 4), 10 senior designers and brand managers in London were

recruited in person using purposive and snowballing sampling. For the online survey described in the same chapter, 62 designers, brand managers, and researchers were recruited using a self-selected sampling by posting a recruitment page on a number of relevant packaging and branding groups identified on LinkedIn[5]. In the colour experiment (Chapter 5), participants were independently selected from a location convenient to the researcher. Twenty-five students in various fields of design, textile, science, education, transportation, and medicine at Leeds University were recruited. In the colour meaning case study (Chapter 7), three groups of participants (students and school staff members at Leeds University, N=10, N=74, and N=25, respectively) were recruited as a convenient sample, and one brand manager who worked for a UK consumer goods manufacturing company was recruited using purposive sampling. In the Design and Refinement Studies (Chapter 8), the eight designers and brand managers who were interviewed in Chapter 4 were re-recruited. In the Expert Evaluation Study (Chapter 9), eight different experts in colour, graphic design, and branding were recruited as a purposive sample. The procedures were described in the relevant chapters.

3.6 Research quality

Reliability and validity are typically used for testing quantitative research, which often proves to be problematic when dealing with qualitative data (Robson, 2011). These notions are more related to positivism rather than constructivism, which has a closely related viewpoint in this study. Reliability refers to the repeatability of the results and is a similar concept as dependability in qualitative research (Long & Johnson, 2000). Validity indicates the accuracy of the measurement means and whether they actually measure what they are designed to measure, and in qualitative research, alternative terms such as quality, rigor, and credibility are used (Guba & Lincoln, 1989; Golafshani, 2003; Robson, 2011). As this PhD study was predominantly based on the interpretation of meanings that participants provided for the study, the concept of reliability was not regarded as a significant issue; therefore, some degree of bias should be considered.

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[5] LinkedIn is a social networking website that connects the world's professionals, which is headquartered in California (LinkedIn website, Accessed 3 February 2015).

However, this does not exclude some kind of generalisability beyond the studies. Golafshani (2003) argued that if the validity can be maximised, more credible results can be acquired that may lead to generalisability. Thus, in order to enhance the validity and minimise the potential bias, audit trail, audio-recording, peer debriefing, and combining methods were carried out in the two main areas of the research: description and interpretation (Robson, 2011).

In order to provide a valid presentation and interpretation of the data, a full description of research activities, including transcripts of interviews, data collection methods, assumptions made, and decisions taken, were presented, which is a technique called an audit trail. Moreover, all the data from the interviews were audio-recorded, transcribed, and transferred into Microsoft Word files. Then, the data were coded using NVivo 10 and displayed in tables. Peer debriefing is carried out to prevent a researcher bias by discussing the findings with knowledgeable colleagues or presenting them to interested groups (Long & Johnson, 2000). For the interview data, the codes and themes were discussed and reviewed by a non-participating researcher (a PhD student at Leeds University) (Chapter 4). In terms of the design outcome for the tool, co-creation of a tool prototype was carried out by professional designers and brand managers (Chapter 8), and the prototype was evaluated by experts (Chapter 9). Mixing methods in research design and data collection can help to increase the validity of the findings (Blaike, 2000; Abowitz & Toole, 2010). Thus, the interviews and online surveys were combined (Chapters 4 and 7), and the within survey instruments and open-ended questions were included (Chapters 8 and 9). In addition, the limitations of each method used for the data collection and analysis are discussed in detail under the 'Critique of methods' section in Chapters 4, 5, 7, 8, and 9.

3.7 Overview of the research design

An iterative design approach was chosen in the design of this exploratory research. Table 3.6 provides an illustration of the research activities conducted for the overall research at a general level. Each data collection and analysis method implemented in the study will be discussed in detail with the justification of methods chosen in Chapters 2,

4, 5, 7, 8, and 9 where issues regarding the validity and reliability of methods will be addressed.

Table 3.6 Overview of research activities

Research activity	Data collection	Data analysis	Objectives	Chapter
Literature analysis	- Secondary resources	Title analysis	- To identify the types of colour information in the literature	2
Interview	- Semi-structured interview (Designers and brand managers N=10)	Qualitative + Statistical analysis	- To investigate the types and the reasons for useful colour information in packaging and branding - To explore what colour information is used by designers and brand managers -To probe designers' and brand managers' preferences and suggestions for a colour tool	4
Online survey	- Online questionnaire (Designers, researchers brand managers N=62)	Statistical analysis	- Triangulation of the interview findings regarding types of useful colour information	
Colour meaning experiment	- Participants are requested to place a slider bar on a scale of 0-100 in the colour it appears (N=25)	Statistical analysis	- To investigate whether colour meanings are affected by context	5
Colour meaning case study	- Semi-structured Interview (Students and school staff members N=10, a brand manager) - Online survey (N=74) - Colour experiment (N=25)	Qualitative + Statistical analysis	-To examine which colour meanings are communicated in a product category	7
Design and Refinement	- E-mail survey and follow-up e-mail interview (Designers and brand managers N=8)	Qualitative + Statistical analysis	- To develop a prototype of colour tool	8
Evaluation survey	- E-mail survey (Experts N=8)	Qualitative + Statistical analysis	- To assess the developed prototype and collect experts' opinions	9

Chapter 4
INTERVIEW AND ONLINE SURVEY

"Colour is a source of great anxiety for modern artists and thinkers"

(Riley, 1995, p.ix)

This chapter presents the results of a study about colour information within the domain of packaging and branding. As preparatory work to achieve this end, Chapter 2 outlined 13 types of colour information (i.e. *colour in art and design, harmony, history, light, meaning, measurement, notation, perception, preference, printing, psychology, theory,* and *trend*) through an analysis of relevant literature and academic references. In this chapter, the aim is to explore the characteristics of colour information classified as useful by design professionals, and preferences and suggestions for a colour tool. Face-to-face interviews with senior designers and brand managers from the packaging and branding fields were conducted as the primary data collection method. In order to support the interview findings, an online survey was also carried out.

4.1 Introduction

The work in this chapter adopted two research methods: face-to-face interviews and an online survey. The interviews were carried out first, and the survey was conducted afterwards. In the interview, senior designers and brand managers (N=10) based in packaging and branding agencies in London were interviewed in person. These face-to-face interviews were intended to gain in-depth understanding of which types of colour information were useful in packaging and branding and why those particular types were useful. It also entailed eliciting what colour information were most often used by professionals. In addition, preferences and suggestions for a colour tool were outlined. The aim of the online survey was to enrich the findings of useful colour information that was obtained from the face-to-face interviews. The participants of the survey were recruited through LinkedIn in order to include professionals in the packaging and branding industries.

This chapter consists of eight sections. Section 4.1 summarises what this chapter intended to achieve. Section 4.2 presents the aim and objectives related to the research questions of this thesis. Section 4.3 explains the data collection methods adopted for this study. Section 4.4 and 4.5 illustrate the justification for the data collection methods, the process of recruiting participants, and the data analysis methods used. After an analysis of the data, the results of the studies are presented along with various data collected from each study. Section 4.6 compares the interviews and online surveys. Section 4.7 discusses the key findings according to the research questions and the limitations of the adopted research methods. The additional inclusion of colour meaning studies (a colour meaning experiment, a colour meaning framework, and a colour meaning case study) and the need for colour tool development for designers and brand managers are discussed within the context of the findings. Section 4.8 completes this chapter, summarises the key insight of the chapter, and briefly introduces the next steps in the research.

4.2 Aim and objectives

Four out of seven research questions for the entire thesis were transformed into the aims for this chapter as follows: a) to investigate the types of useful colour information in packaging and branding and b) to determine why each particular type of information is important; c) to explore what colour information is used by designers and brand managers; and d) to investigate designers' and brand managers' preferences and suggestions for a colour tool. These aims were broken down into the following objectives:

1. To explore how designers and brand managers decide about colour.
2. To identify the types of important colour information in packaging and branding.
3. To discover insights for the identified colour information in objective 2.
4. To explore what colour information is used by designers and brand managers and
    how they source colour information.
5. To collect preferences and suggestions regarding a colour information tool.

4.3 Data collection methods: Interview and online survey

Face-to-face interviews and an online survey were designed and carried out. The purpose of employing two data collection techniques was to obtain the complementarity to elaborate more fully on the results gathered from one method with those from another (Greene *et al.*, 1989).

• Interview

As the primary data collection method, the face-to-face interviews were designed to mainly answer research questions one to four. The interviews aimed to collect in-depth understanding on the characteristics of useful colour information itself and to serve as a tool for professional users. A card-sorting technique was adopted to identify the different types of useful colour information. This technique is described in detail in Section 4.4.2. In order to collect preferences for a colour tool, a multiple-choice questionnaire was verbally conducted that presented four types of existing colour tools (e.g. website or publications) and six types of data types (e.g. textual or visual). The designers and brand managers were first asked to select any tool type or data type based on their preferences, and then they were requested to provide comments verbally on their choices. Therefore, both qualitative and quantitative data were collected and analysed during the interviews.

• Online survey

An online survey was designed in a subordinate manner to the interviews for the first research question (which colour information is useful in packaging and branding?). Quantitative data were collected and analysed for this study.
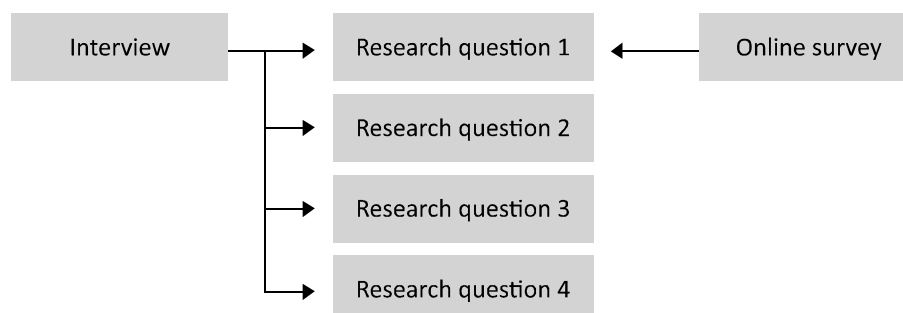
Figure 4.1 Data collection methods to answer research questions one to four

4.4 Interview

There are three types of interviews: structured interviews, semi-structured interviews, and unstructured interviews (Robson, 2011). Structured interviews have predetermined questions with a fixed wording and order. In semi-structured interviews, the researcher uses a prepared list of questions, but it is not fixed. The order of the questions can be modified, and additional questions can be included based on the flow of the interview. The unstructured interviews have no predetermined list of questions like an everyday conversation. These interviews can be carried out on an individual or group basis, such as a focus group.

4.4.1 Justification of using face-to-face interviews

In this chapter, the semi-structured interviews were chosen, and a one-to-one interview format was selected rather than a group interview. All participants were asked 18 identical open-ended questions. However, the interviewer probed the participants based on their responses (Guest *et al.*, 2006). This process aimed to ensure the data needed for this study was gathered and had both depth and variety. A group interview could be used as it is comparatively convenient and inexpensive (Sim, 1998). However, the research focus of this study was set up to include practicing designers and brand managers, but it was extremely difficult to recruit professional participants. Considering the difficult situation in sampling, it was impossible to gather participants together at the same time.

Once the one-to-one interview method had been chosen, the next step was to decide how to conduct the interviews. There are several options that can be used to communicate with participants, such as in person, by telephone, or using other electronic media. In the case of the telephone or electronic media, the researcher does not need to spend time and money for transportation, although in this situation the participants are scattered over a wide geographical area (Kumar, 2005). Despite the advantages, there are some limitations of telephone interviews and online interviews. The limitation of the telephone interview is that participants could be less cooperative on the phone than face-to-face participants (Holbrook *et al.*, 2003). Moreover, visual aids,

such as the use of pictures, are impossible in telephone interviews. The limitation of utilising online media (e.g. Skype) is that participants could be distracted by unexpected occasions (e.g. arriving e-messages) during the interview. The purpose here was to elicit in-depth opinions on useful colour information and on a potential a colour tool. Considering all these reasons, the face-to-face method was selected as the main method in this study.

4.4.2 Data collection instruments

This section describes the instruments used to collect the data needed for the research. The first step in designing the interview questions was to specify the type of data needed. Based on the aims and objectives of this chapter, the main topics were drafted and the topics were then converted into interview questions with special consideration for the order of the questions. The interview questions were pretested to ascertain how long it would take to complete them and also to verify that the questions were clear and to find the best arrangements for the order of the questions. The questions were finalised after an initial pilot test of two other design research students (PhD students at Leeds University). The pilot test did not reveal any major problems and proved helpful to gain some invaluable interview experience and to explore methods for qualitative and quantitative analysis. The final version of the interview questions included five criteria: participants' profile, colour decision, types and reasons of important colour information, current use of colour information, and preferences and suggestions (Table 4.1). A copy of the interview protocol is provided in Appendix B4.

Part A. Participants' general information such as their name, years of work experience, job title, age, and gender, was collected. This section was aimed at qualifying the participants who worked in packaging and branding in medium and high management roles.

Part B. Participants were asked how they chose colours in their recent design projects. This section intended to gain an overall understanding of colour decision in design practice.

Part C. Participants were asked to provide important colour information in three situations, such as a recent design project, a given colour decision task, and a general design process. The questions were created to investigate which type of colour information is useful in the general design process and aimed to collect in-depth responses on the selection of particular colour information. In the questions, participants were provided with 13 cards involving pictures and descriptions. Card sorting was performed because this is a useful technique to distinguish between high- and low-level issues (Barrett & Edwards, 1995). The definitions indicated for the 13 cards were derived from those previously explained in Section 2.3.4, and the images for the cards used as visual displays during the interview can enrich the study of participants' opinions (Holbrook *et al.*, 2003). Figure 4.2 shows the 13 cards used during the interviews (see Appendix B5).
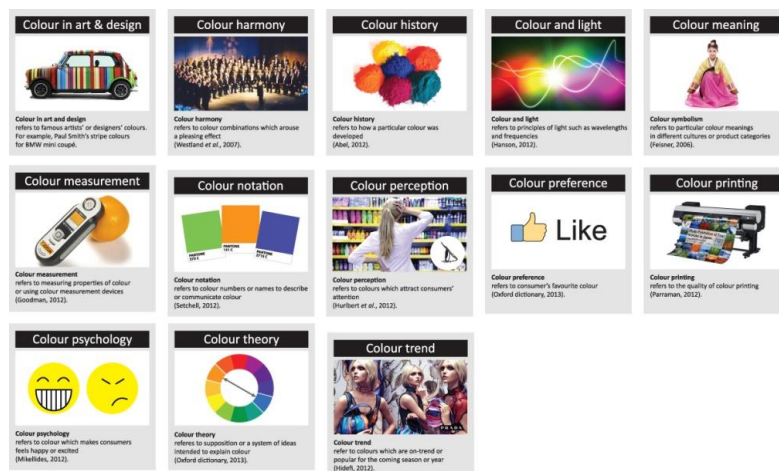
Figure 4.2 The 13 cards used for card sorting

The card sorting proceeded according to the following three steps:

1. Before the sorting began, the participants were given time to read all the cards.
2. Then, participants were asked to sort the cards into two groups (important/less important) in three situations, such as a recent project, a given task, and a general design process, as shown in Figure 4.3.
3. After the sorting was finished, the participants were asked to verbally provide the reasons for the chosen card.

66

Figure 4.3 Example of cards sorted by a participant

Part D. Participants were asked what colour information they use. The aim of the questions was to explore what format of colour information they used and where they sourced the information.

Part E. Participants were finally asked to provide their preferences and suggestions for a colour tool. A list of four colour information tools and of six data presentation types were presented to the participants to stimulate their thinking, as shown in Figures 4.4 and 4.5.
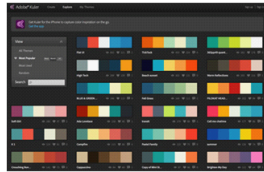
| a. Book & journal | b. Website | c. Software | d. Mobile app |
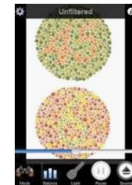
Figure 4.4 Four types of existing colour tools presented to participants

| a. Statistics & charts | b. Description & explanation | c. Pictures & videos | d. Diagrams, graphics & maps | e. Colour palette | f. Colour wheel |
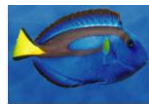
Figure 4.5 Six types of data presentation presented to participants

Table 4.1 A summary of the interview structure and purposes

	Categories	Purpose of questions
Part A	Participants' general information	To qualify participants
Part B	Colour decision	To understand colour decisions in design practice
Part C	Types and reasons of colour information in a recent project, a given task, and a general design process	To investigate which colour information is useful in the general design process and to collect insight as to why
Part D	Current use of colour information	To explore what colour information is used by users
Part E	Preferences and suggestions	To collect preferences and suggestions for a colour tool

4.4.3 Recruitment of participants

To be eligible for the study, participants needed to be senior designers or brand managers in the packaging and branding industries. Initially, 40 top UK award-winning packaging and branding agencies, nine large food companies (e.g. Unilever, Nestle, M&S, Britvic, etc.), and a colour consultant belonging to the UK Colour Group were contacted by e-mail. A recruiting e-mail (Appendix B1) was sent to them, and designers or brand managers with medium or high management roles were targeted. There were two main reasons for contacting experienced professionals from design agencies or large companies. The first was because senior experts are more aware of relevant issues and what is the most important (Ahmed *et al.*, 2003). Thus, significant topics and opinions on colour in design practice can be more thoroughly collected. Secondly, these professionals were targeted to screen unintended participants, such as freelancers who might have had an obscure career. Recruiting professional participants was extremely difficult and time consuming. Finally, two participants (one brand manager in a branding agency and one colour consultant) agreed to be interviewed in person. After interviewing the two participants, other participants, one after another, were contacted as snowballing sampling. Guidelines for determining adequate sample sizes are virtually non-existent (Morse, 1995; Creswell, 1998) and they depend on the data saturation point, which occurs when new information is no longer observed in the data (Guest *et al.*, 2006). Guest *et al.* (2006) suggested that six interviews are sufficient to collect

meaningful findings. Since data saturation was achieved after six interviews, we decided that 10 interviewees represented an adequate sample size for this research.

The size of the design agencies varied from small (under five employees) to medium (16-25 employees) to large (over 65 employees). The majority of the interviewees had more than 10 years of work experience with the exception of one interviewee (with approximately 6-9 years work experience). Table 4.2 provides a description of these participants in detail. The specialised area of the design agencies, the interviewees' work position in the agency, and their years of experience were outlined.

Table 4.2 Profiles of interviewed designers, brand managers, and a colour consultant

Interviewee ID	Specialised area & Number of employees	Interviewee position	Interviewee years of experience
A	Branding (65)	Managing partner	More than 20 years
B	Branding (300)	Strategy director	10-19 years
C		Executive creative director	More than 20 years
D		Group director	10-19 years
E	Packaging (25)	Creative managing partner	More than 20 years
F		Design director	10-19 years
G	Branding (under 5)	Colour consultant	6-9 years
H	Branding (under 5)	Creative director	More than 20 years
I	Branding (under 5)	Creative director	
J	Branding (16)	Design director	

4.4.4 Interview process

The interviews took place as follows:

Setting up. All participants received an information sheet (Appendix B2) and the interview questions by e-mail in advance before the interviews were carried out. The information sheet outlined the use of the data and the participants' rights to withdraw from this study.

Venue. All the interviews except one took place in the office room of the design agencies. The one interview was conducted in a member's room at the London Southbank Centre.

All venues for the interviews were chosen based on the participants' preference and the availability to record their voice during the session.

Duration time. The interview time was generally within 40-60 minutes.

Introduction. The interviews consisted of one interviewer (the researcher) and one interviewee. Before commencing the interview, an informed consent form (Appendix B3) was signed by the interviewee, and the interview began with a brief introduction of the research project and icebreaker words.

Main body of the interview. As a first interview question, the interviewees were asked how they had chosen colours in their recent design project. Following that, specific questions were asked regarding the characteristics of useful colour information. Finally, designers' and brand managers' preferences and suggestions for a useful colour information tool were discussed. The interviews were all audio-recorded with the interviewees' permission.

4.4.5 Data preparation and analysis method

Qualitative and quantitative data were collected in the interview. The qualitative data were transcribed for analysis, and the quantitative data were collected in the form of frequencies in regards to colour information types, tool types, and data presentation types. For the qualitative data analysis, a 'template approach' (King, 2012) was used. The template approach is a coding and organising data method (King, 2012). For the quantitative data analysis, descriptive statistics were used based on the simple counting of frequencies regarding the selection of colour information types and preferences for colour tools and data presentation types.

Waring and Wainwright (2008) suggested four sequential steps for the template approach as follows. Step 1): creating a coding scheme. Step 2): coding the data by hand or with computer software. Step 3): gathering similar data in one place. 4): revising codes. In order to transcribe the audio-recorded interviews and carry out the analysis, NVivo 10, which offers quick and easy access to coded material (Robson, 2011), was

used. The transcribed data from each interview was first coded based on some words or phrases related to the interview questions (Waring & Wainwright, 2008). The descriptive themes that are close to the data were narrowed to interpretive themes. Finally, the data were clustered in one place. For example, participants were asked a question, such as 'how did you decide on a colour in your recent design project'? Figure 4.6 demonstrates a passage from a transcription. The word 'brand' was identified as being linked to the question, and then it was coded using a phrase such as 'through understanding a brand, market, and audience', as shown in Figure 4.7.

(An identified passage)   **(A coded word)**

The other important aspect from where we were   Through understanding a brand,
considering colour was this brand because it was   market and audience
based on this idea of exciting flavours
and variety of flavours and structures.
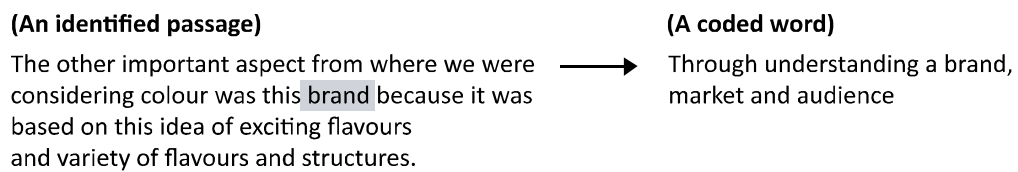
Figure 4.6 An example of an initial coding

Figure 4.7 An example of themes in a hierarchical coding scheme

(captured on NVivo 10)

4.4.6 Results

The interviews provided information on the following six topics:

1. Colour decision
2. Types of useful colour information
3. Reasons for this useful colour information
4. Current use of colour information
5. Preferences for existing colour tool types and data types
6. Suggestions for a colour tool

Tables 4.3 through 4.9 and Figures 4.8 through 4.11 summarise the key findings regarding each topic. The results were tabulated with various coded themes and indications of frequencies that were mentioned by the interviewees. For each result table, the maximum frequency was 10 (because the total number of participants was 10). No matter how many times the specific response was mentioned by one interviewee throughout the interview, it was counted as being mentioned only once. The responses most frequently mentioned are presented at the top of the list. However, regarding the results of useful colour information types, Figure 4.8 displays the number of frequencies individually (i.e. a frequency provided by designers and a frequency provided by brand managers). In these cases, the maximum frequency was five because there were five designers and five brand managers.

4.4.6.1 Colour decision

Table 4.3 presents how the colour decision was made in their recent design project and the number of frequencies mentioned by the interviewees. The results indicated that colour decisions generally are made based upon a person's understanding of a brand, market, and target audience.

Table 4.4 presents a summary of a recent project stated by each interviewee. Some of design projects concerned global brands such as Pringles and Kellogg's, whereas others involved work related to small businesses. Overall, the recent design projects mentioned

by the participants were divided into two categories: redesign projects and new projects. In the case of redesign projects, the colour decisions had many constraints, whereas new projects allowed a wide range of colour selections. The redesign projects for an existing brand's packaging aimed to redirect the brand against a different target audience and revitalise the design. The main colour concern in a redesign project was that the brand might lose consumers by changing the original colour. In other words, the consumers have already learned the messages from the current colours of the existing brand pack; therefore, making a big colour move could cause misunderstanding or be confusing for consumers. For this reason, most of the redesign projects only allowed a change in tonality (e.g. keep the same hue and control brightness or chroma to make it warm or cool). This trend indicates that great care and discretion are needed for colour decisions when companies launch a new brand since once it has been launched, the original colour may be retained for a long time.

Table 4.3 Colour decisions in a recent project

Colour decision in a recent project	Frequency of mentions
Understanding a brand, market, and target audience	9
Based on a design brief or client-provided information	6
Choosing a generic or differentiated colour	5
Considering what meaning the colour communicates	4
Depending on personal intuition	3

Table 4.4 Recent design project of interviewees A-J

Interviewee	Recent project	
A		• Redesign project Repositioning and re-launching the brand
B		• Redesign project To refresh the packaging of global food brands

C		• Redesign project To involve richness and a contemporary feeling
D		• Redesign project To involve richness and contemporary feeling
E		• Redesign project To break a category norm
F		• Redesign project To involve premium quality product feeling
G	No image	• New project Project's name was anonymous due to an NDA (non-disclosure agreement)
H		• New project To design packaging, booklets and website
I		• New project Logo design

J		• New project
		  Branding for a new luxury apartment in London
		  Property name, logo, and colour plan for interior

4.4.6.2 Types of useful colour information

This section divided the findings from two types of categorisation: designers' and brand managers' responses vs. overall responses. For the designers' and brand managers' responses, Figure 4.8 shows the frequency distribution regarding the importance of each type of colour information. As mentioned previously, the total number of participants was 10; half of them were designers, and half of them were brand managers. Therefore, the highest frequency for each group was five. The results of the frequency from 'designers' indicated that 'printing', 'harmony', 'meaning', 'notation', and 'perception' were important. The frequency results from 'brand managers' revealed that 'harmony', 'perception', and 'psychology' are important (as stated by at least four people out of five from each group of designers and brand managers).
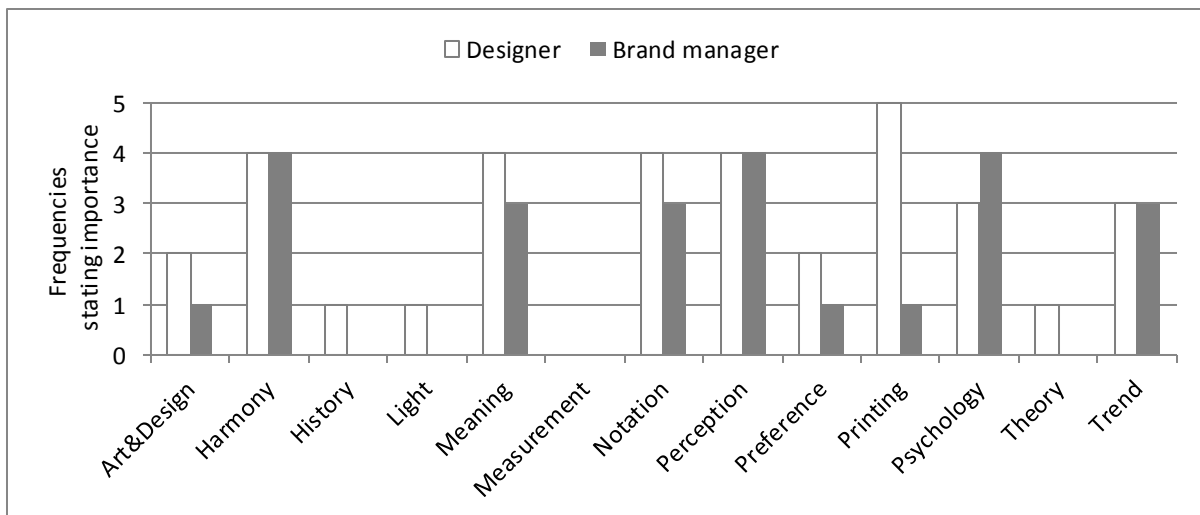
Figure 4.8 Frequencies stating importance (designers' and brand managers' responses)

Figure 4.9 presents the frequency distribution of importance on each type of colour information for the overall responses. Recall that the overall number of participants was now 10, which means the maximum frequency could also be 10. Somewhat arbitrarily, a frequency greater than 7 out of 10 will be considered as very important; frequencies between 5 and 7 will be considered important, while frequencies less than 5 will be considered not important. According to the interviews, it could now be concluded that harmony and perception are all very important; that meaning, notation, printing, psychology, and trend are important; and that the others are unimportant. This

information will be discussed again in Section 4.6 in a comparison of the results from an online survey.
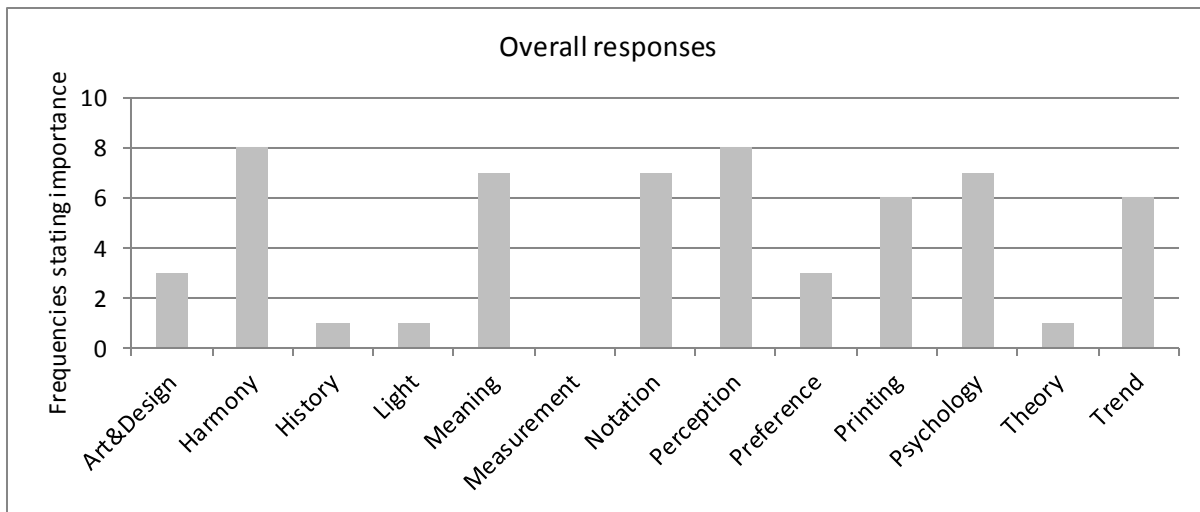
Figure 4.9 Frequencies stating importance (overall responses)

4.4.6.3 Reasons for useful colour information

Table 4.5 presents a summary of the reasons why the particular colour information was reported as important by the interviewees. The 'Comments' cell presents the comments provided by the interviewees regarding their choice for each type of colour information, and the 'Frequency of mentions' cell indicates how many times the comments were mentioned by the interviewees.

Table 4.5 Interviewees' comments on the 13 types of colour information

Colour information	Comments	Frequency of mentions
Colour in art and design	Starting point	1
	Underling	1
Colour harmony	Intuitive	4
	To visually appeal	1
Colour history	Not deal with	1
Colour and light	Not deal with	1
	Too scientific	1
Colour meaning	To convey messages	6
	Cultural	1
	Conscious	1
Colour measurement	To achieve an exact colour	2
Colour notation	Production aspect	3
	To avoid miscommunication	2
	Just a tool	1
Colour perception	To stand out	6
Colour preference	Not constant, personal	4
Colour printing	For the end result	4
	Practical point of view	1
Colour psychology	To create a response	5
	Not constant, personal	1
Colour theory	Not deal with	2
Colour trend	For the luxury, beauty, interior, and FMCG category	2
	Not constant	2
	It's only marketing	1
	Somebody else's guess	1
	Underling	1

4.4.6.4 Current use of colour information

Table 4.6 presents a summary of what colour information was used by designers and brand managers. The current use of colour information was reported as very limited and mainly used a colour matching system. The main source of colour information was from self searching or clients' briefs. Most respondents reported not being aware of a satisfaction with current colour information. Also, it was reported that there is a strong demand for colour information for backing up reasons in terms of their colour choice.

Table 4.6 Current use of colour information

Current use of colour information	Frequency of mentions
Pantone chips	6
No use of formal colour information	4
Colour palettes in reference books	1
Colour trend report	1
Source of colour information	
Self searching using books, websites, Photoshop, or Illustrator or visiting stores	7
Client's brief	4
Trend analyst, colour consultant	3
Colleagues	2
Seminars, lectures	2
Paint or plastic manufacturers	1
Satisfaction with colour information	
Not aware of	4
Quite satisfied	2
Needs to be refined and processed	1
Hard to access	1
Scattered	1
Not interesting	1
Quite reliable	1
Role of colour information	
Solid back up	5
Quick, easy and informed decision	4
Breaking a category norm or new trial	2
Better understanding of colour	1

4.4.6.5 Preferences of existing colour tool types and data types

Figures 4.10 and 4.11 present a summary of the preferred colour tool type and data type (see Appendix B3 and B4 for more information about these). It has been reported that the most preferred tool type was websites and the most preferred data type was colour palettes.
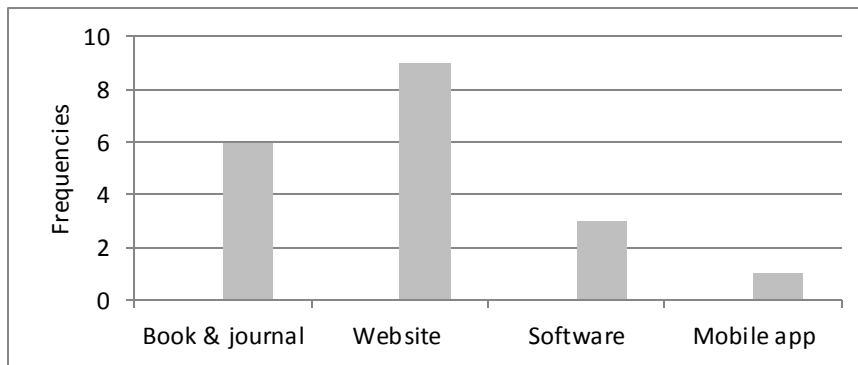
Figure 4.10 Frequencies of preferences for tool types
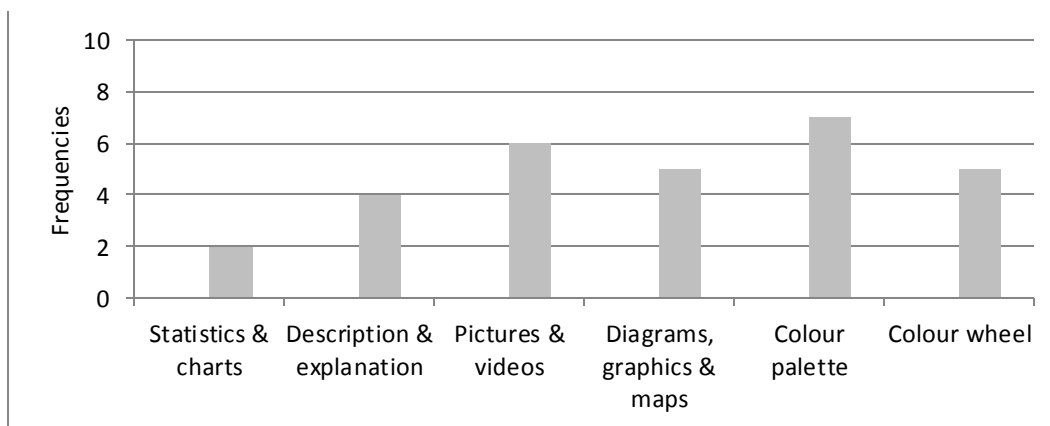
Figure 4.11 Frequencies of preferences for data types

Tables 4.7 and 4.8 present a summary of comments stated by interviewees in regards to the tool type and data type. The 'Comments' cell includes any comments made, and the 'Frequency of mentions' cell indicates how many participants chose the tool and data type as the most preferred.

Table 4.7 Interviewees' preferences and comments on the four colour information tools
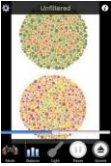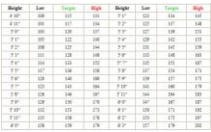
Colour information tool	Comments	Frequency of mentions
a. Book and journal	Interesting, specific, inspiring	3
	Tactile	2
	Expensive	2
	Reliable	2
	Outdated	1
	Heavy	1
	Traditional	1
b. Website	Interesting, specific, intuitive	4
	Able to work on desktops	3
	Quick and easy	3
	Unreliable	2
	Didactic	1
	Reactive	1
	Practical	1
	Sharable	1
c. Software	Irrelevant	2
	Not easy to use	1
	Able to work on desktops	1
	To choose a specific colour	1
	Quick	1
d. Mobile app	Personal use	2
	Unreliable	1
	Handy, quick	1
	Low quality of colour	1
	Irrelevant	1

Table 4.8 Interviewees' preferences and comments on the six data presentation types

Data presentation	Comments	Frequency of mentions
a. Statistics and charts	Textual	1
	Useful	1
	Too technical	1
	To justify colour choice	1
b. Description and explanation	Textual	2
	Useful	2
	Boring	1
	To justify the colour choice	1
c. Pictures and videos	Inspiring	3
	Visual	2
	Relevant	2
	Easy	1
d. Diagrams, graphics, and maps	Quick, easy, understandable	2
	Relevant	2
	Interesting	1
	Modern, engaging	1
e. Colour palette	Visual	3
	Easy	3
	Relevant	3
	Interesting, inspiring	2
f. Colour wheel	Helpful	2
	Not processed	2

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4.4.6.6 Suggestions of a colour tool

Table 4.9 presents the summarised the suggestions and ideas for a potentially useful colour information tool that were provided by the interviewees. The 'Suggestions' cell presents ideas offered by the interviewees for a colour tool, and the 'Frequency of mentions' cell shows how many times the suggestions were mentioned by the interviewees.

Table 4.9 Interviewees' suggestions regarding a useful colour tool

Suggestions	Frequency of mentions
Colour meaning or predominant colour by product categories	6
Colour insight or learning	4
Colour combinations	3
CMYK, RGB, NCS, and Pantone code	3
Which colour will attract attention	3
Colour trend	3
Individuals' responses	2
Researched	2
Device to match a colour from a design to print or to identify a colour on the product	2
Regularly updated	1
Community site	1
Colour psychology	1
Inspiring website	1

The most desired feature for a colour tool that was suggested by 6 out of 10 interviewees was the colour meaning or predominant colour in different product categories. For the colour meaning in different product contexts, one interviewee stated the following: "If I want to understand the Brazilian market, I need to understand what red and blue mean: if it could bring out everything in that market that uses red and blue, whether it is a flag, whether it is a government, institutions, brands. That would be a really fascinating tool for me because a lot of our work is international" (Interviewee B). For the predominant colour in a different context, another interviewee stated the following: "Context, it's important. One colour in crisps might have a completely different response from the same colour in cars or in laundry detergents or biscuits. If

that's the way category looks at the moment, what colours might be right in terms of interruption, and why? Why might that be interesting and appropriate?" (Interviewee A). The interviewees wanted to know what is and what would be an appropriate colour depending on the product categories. Some suggestions were challenging, such as "inventing a new device that could help match a colour perfectly from design to print" (Interviewee C) and "identifying colours on the product" (Interviewee D). A fully up-to-date, researched colour information and colour community site, including a conversation section, a learning section, and an inspiration section were also some of the diverse ideas provided for a useful colour tool.

4.5 Online survey

As has been stressed previously, the aim of the online survey was to support the interview findings in regards to research question one (which colour information is useful in packaging and branding?). The following sections describe the justification of using the online survey (and particularly the use of scaling questions), the process by which participants were recruited, and the methods of data analysis.

4.5.1 Justification of using online survey

A web-based survey was selected over postal or telephone surveys as it has many advantages (Robson, 2011). The advantages over postal surveys are that it is less expensive, faster to complete, and has a higher response rate (Cobanoglu *et al.*, 2001). The advantage over telephone surveys is that it is possible to use visual aids (Holbrook, 2003). QuestionPro[6] was chosen as the online survey creation and distribution tool, and target participants were approached through LinkedIn[7].

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[6] QuestionPro is a private American company that enables users to build their own online survey (QuestionPro website, Accessed 28 February 2015).

[7] LinkedIn is a social networking website that connects the world's professionals, which is headquartered in California (LinkedIn website, Accessed 3 February 2015).

4.5.2 Type of questionnaire and scale

During the questionnaire design stage, questions can be formulated as two types: open-ended and closed-ended (Kumar, 2005). An open-ended question does not offer possible responses, and participants typically provide answers in their own words. A closed-ended question provides a ready-made list of answers, and participants or investigators tick the category that best describes their answer.

In this chapter, since this online survey was designed to support the interviews, the same phrasing and pictures regarding the 13 types of colour information were used for consistency. Moreover, the questionnaire for the main questions was constructed in a closed-ended manner because it is easier to make comparisons with interview results (Vinten, 1995). For participants' general information, such as their job tile and design industry, open-ended questions were included to allow the participants to select a 'please specify' response. This option was chosen was because it is helpful to qualify and screen eligible participants in the data analysis stage.

The next step was to choose the best type of scales. There are commonly used scales, such as the Thurstone scale, Semantic differential scale, Guttman scale, and Likert scale (Robson, 2011). The Thurstone scale is an interval scale that requires mathematical procedures. The Semantic differential is used to measure subjective attitudes using bi-polar words. The Guttman scale is a cumulative scale that can obtain a pattern of participants' responses. Likert scaling is a scaling method used to measure either positive or negative response to a statement.

In this chapter, a direct magnitude scale was used in a Likert-type fashion. A direct magnitude scale is one of the various scaling formats in which the participant is given a scale and asked to write (or state) a number that represents his or her response (Diamantopoulos & Schlegelmilch, 2000). This scale was chosen because a Likert scale generally provides five options of choice, which may limit the subsequent statistical analysis. Figure 4.12 presents the direct magnitude scale used for this study. A slider bar on a scale of 0-100 was used for participants to indicate how important each of the 13 types of colour information were in their design process or strategy (where 0 = no

importance at all and 100 = vital).

Q. In your design strategy or design process, how important (on a scale of 0-100) is it for you to know the colours that famous artists or designers use or like?

Figure 4.12 Example of the magnitude scale used for this study

The final step was piloting the questionnaire. This step was carried out by one lecturer specialising in colour at Leeds University and four PhD students (three at Leeds University and one at Queen Mary University of London) in order to assess the overall structure and clarity of the survey. The participants were also asked how long it took to complete the survey. After completion, all participants were asked to give their feedback on the survey. There were no major issues, and the final questionnaire was amended so that it could be completed in approximately 5 minutes (Appendix B6).

4.5.3 Recruitment of participants

A self-selected sampling method was used in which potential participants were informed about the survey and allowed voluntary participation (Walsh *et al.*, 1992). LinkedIn was used to recruit professional designers and brand managers to take part in the survey. A number of relevant design and branding groups were identified through a search function on the LinkedIn website. In total, 15 design- and branding-related groups were identified, and a survey link was posted on the pages of these groups so that potential participants could choose to take part in the survey subsequently (unrestricted self-selected method). The identified LinkedIn groups were Graphic Design Professionals, Design Research, Graphic Design Professional Group, Colour Marketing Group, Packaging Design, Packaging Professionals, Logo Designers Collective,

Packaging Connections, Package Graphic Design, Brand Management, Packaging World, Brand Innovators, Brand Lounge, Design Plus, and Brand Packaging.

4.5.4 Survey process

The online survey was posted on the public discussion pages of the LinkedIn groups identified in Section 4.5.3. In order to encourage participation, the following steps were adopted:

Setting up. A relevant title, the link to the questionnaire, and a short introduction to the survey were provided. The paragraph was posted on each LinkedIn group as shown in Figure 4.13.

Reposting. The survey was reposted every two weeks.
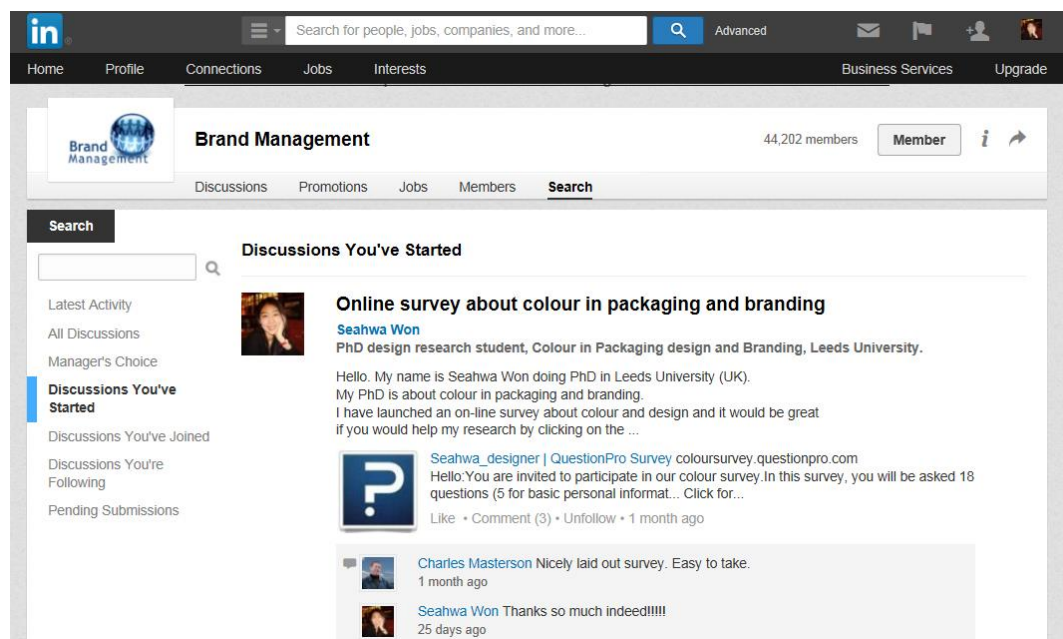
Figure 4.13 Image captured on LinkedIn

4.5.5 Data analysis method

This section outlines the statistical techniques used for data analysis. The selected methods are presented under descriptive statistics and inferential analysis. The key

analysis methods that were used are briefly illustrated.

Descriptive statistics summarise the data to describe what appeared in the sample (Allua & Thompson, 2009). This information provides the frequency distribution, the mean, and the standard deviation of the values reported for each variable. The aim of the descriptive data analysis in this study was to show the mean of the values, such as colour information, as rated by the participants.

Inferential statistics are used to compare two or more samples or to explore the relationship between two or more variables (Marshall & Jonker, 2011). Many statistical methods can be applied to compare two or more samples to investigate differences between them. In order to explore whether there are any differences in the use of colour information between the three groups (designers, brand managers, and researchers) that participated in the online survey, a one-way ANOVA was carried out. A one-way ANOVA is a frequently used method to determine whether there are any significant differences between the means of three or more independent groups (Robson, 2011). In the comparison of the results of the interview and the online survey, the R-squared was used to explore how much the two variables are related (Robson, 2011).

4.5.6 Results

In total, 62 responses were received for the web-based survey. In summary, two important findings can be drawn from the survey. First, there were 'no differences' in the use of colour information between the three groups (designers, brand managers, and researchers). Second, 'printing', 'harmony', 'meaning', 'psychology', and 'perception' were all important. However, to draw a final conclusion for the first research question, it is necessary to also compare these findings with the interview results (see Section 4.6). The following sections describe the process and results of the data analysis from the online survey.

4.5.6.1 Participants' position

Overall, 69 people started or completed the survey, but the final number of completed

surveys was 62. As part of the preparation process, the data were screened by checking the accuracy of data entered, unintended participants, and incomplete responses. Out of the 62 participants, it was clear from the responses that some were researchers (N=11). Although the focus of the survey was on designers and brand managers in packaging and branding, these 11 participants who selected the category 'researcher' were nevertheless included in the data set. The main reason was because they were recruited from within the packaging and branding area identified through the LinkedIn groups; while some of them could have been professional practitioner-researchers, others could still have been potential users. Table 4.10 presents the breakdown of participants' positions.

Table 4.10 Participants' positions

Survey participant Breakdown (Position)	No.	Transitory participant Breakdown	No.	Final participant Breakdown (Position)
Designer	18	18	23	Designer
Design strategist	6			
Brand manager	9	21		
Colour consultant	6		28	Brand manager
Design researcher or academic	8	8		
Other	15	5 (Designer or artist)		
		3 (Design researcher)	11	Design researcher
		7 (Manager or consultant)		
TOTAL	62	62	62	TOTAL

4.5.6.2 Types of colour information

Figure 4.14 shows the mean score for the importance for each type of information as reported by designers, brand managers, and researches. For designers, printing was considered to be the most important (mean importance score: 86.6), whereas history was least important (33.1). Amongst brand managers, printing was most important (84.3) while light was least important (29.6). For researchers, meaning was most important (94.8), and light was least important (45). It is evident from Figure 4.14 that the pattern of responses was rather similar for these three groups.

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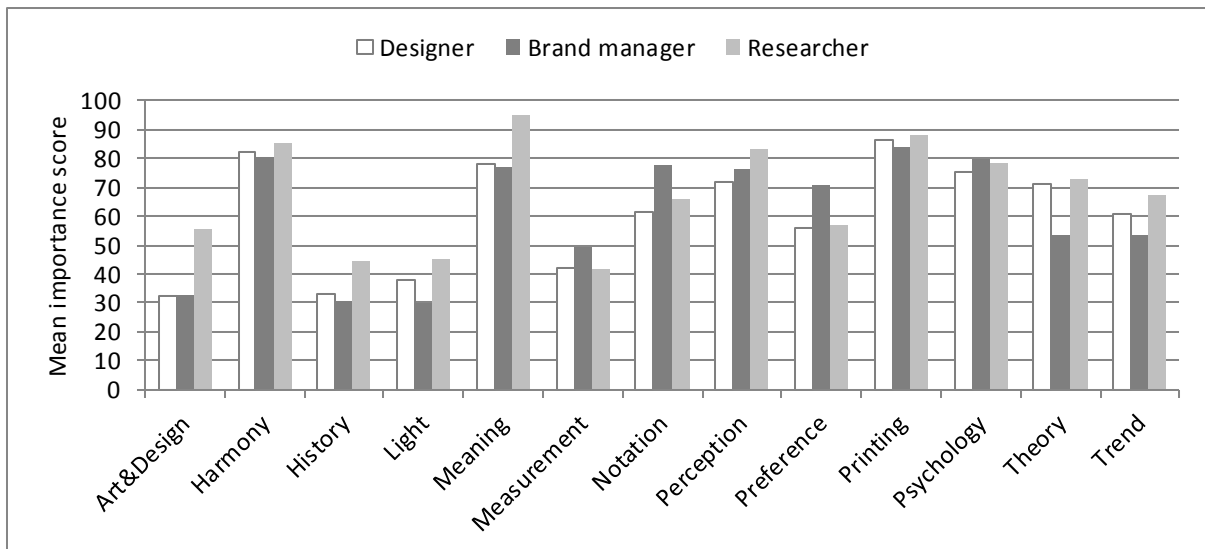
Figure 4.14 Designers', brand managers', and researchers' responses

In order to formally test for significant differences between the three groups, a one-way ANOVA test was used. Table 4.11 shows the results. The table provides some descriptive statistics, such as the number of participants, the mean importance score, and the F and P-values. The results indicate that there is 'no significant difference' between the three groups.

Table 4.11 Results of one-way ANOVA (colour information vs. the three groups)

Colour information	Groups	N	Mean	F	P-values
Art and design	Designer	23	32.17	2.91	0.06
	Brand manager	28	32.93		
	Researcher	11	55.64		
	Total	62	36.68		
Harmony	Designer	23	82.48	0.14	0.87
	Brand manager	28	80.61		
	Researcher	11	85.36		
	Total	62	82.15		
History	Designer	23	33.13	0.88	0.42
	Brand manager	28	30.36		
	Researcher	11	44.27		
	Total	62	33.85		
Light	Designer	23	37.57	1.09	0.34
	Brand manager	28	29.61		
	Researcher	11	45.00		
	Total	62	35.29		

Meaning	Designer	23	78.09	2.47	0.09
	Brand manager	28	76.93		
	Researcher	11	94.82		
	Total	62	80.53		
Measurement	Designer	23	41.74	0.37	0.69
	Brand manager	28	49.46		
	Researcher	11	41.36		
	Total	62	45.16		
Notation	Designer	23	61.52	1.71	0.19
	Brand manager	28	77.61		
	Researcher	11	66.00		
	Total	62	69.58		
Perception	Designer	23	71.74	0.66	0.52
	Brand manager	28	76.29		
	Researcher	11	83.64		
	Total	62	75.90		
Preference	Designer	23	55.74	1.75	0.18
	Brand manager	28	70.96		
	Researcher	11	56.82		
	Total	62	62.81		
Printing	Designer	23	86.61	0.13	0.88
	Brand manager	28	84.25		
	Researcher	11	88.18		
	Total	62	85.82		
Psychology	Designer	23	75.04	0.19	0.83
	Brand manager	28	79.54		
	Researcher	11	78.27		
	Total	62	77.65		
Theory	Designer	23	71.13	2.59	0.08
	Brand manager	28	53.39		
	Researcher	11	72.91		
	Total	62	63.44		
Trend	Designer	23	60.61	0.67	0.52
	Brand manager	28	53.75		
	Researcher	11	67.45		
	Total	62	58.73		

Since there was no difference between the groups, the data from the three groups can be pooled and considered as a single population. Figure 4.15 shows the mean importance score for each type of information when all the participants' responses were considered. The error bars show the ±1 standard error of the mean. Printing was considered to be

most important, and history was reported to be least important. Somewhat arbitrarily, scores greater than 70 were considered as very important; scores greater than 50 and 70 or less were labelled important, while scores of 50 or less were considered unimportant. According to the survey, it can be concluded that printing, harmony, meaning, psychology, and perception are all very important, that notation, theory, preference, and trend are important, and that the others are unimportant.
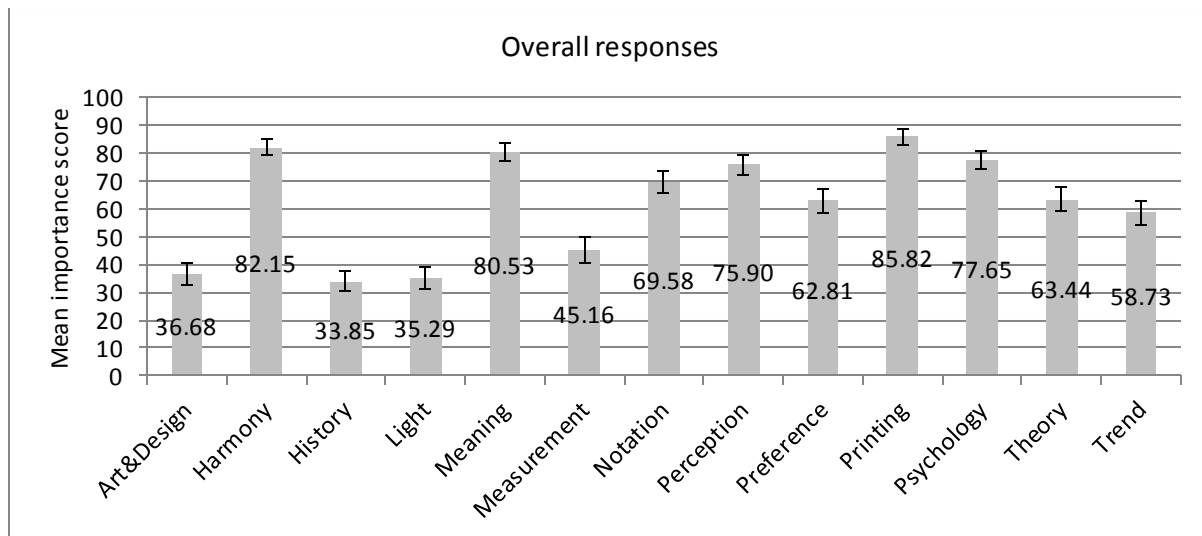
Figure 4.15 Participants' overall responses

4.6 Comparison of the interview and the online survey

In this section, the results from the online survey are compared with those from the interview to draw more robust conclusions in terms of which colour information is useful in packaging and branding. In order to explore how close relationships are amongst the data from the interviews and the online surveys, R-squared was used, which is a statistical measure of how close data are to the fitted regression line (Robson, 2011) and can be seen as a measure of correlation (high R-squared values imply strong correlation).

The interview and online survey data were compared (Figure 4.16). However, statistical analysis of the interview responses was difficult, partly because the sample size was low (N=10) and also because the responses were made up of 'binary' rather than 'interval'

data. Nevertheless, when the per cent importance (from the interviews) was compared with the mean importance scores (from the surveys), there was strong agreement (see Figure 4.17) between the two studies ($R^2 = 0.66$). Therefore, taken together, the average of the per cent importance and the mean importance scores was calculated.

Conclusively, harmony, perception, meaning, psychology, and printing were deemed to be very important because the mean is greater than 70 (per cent or mean score).
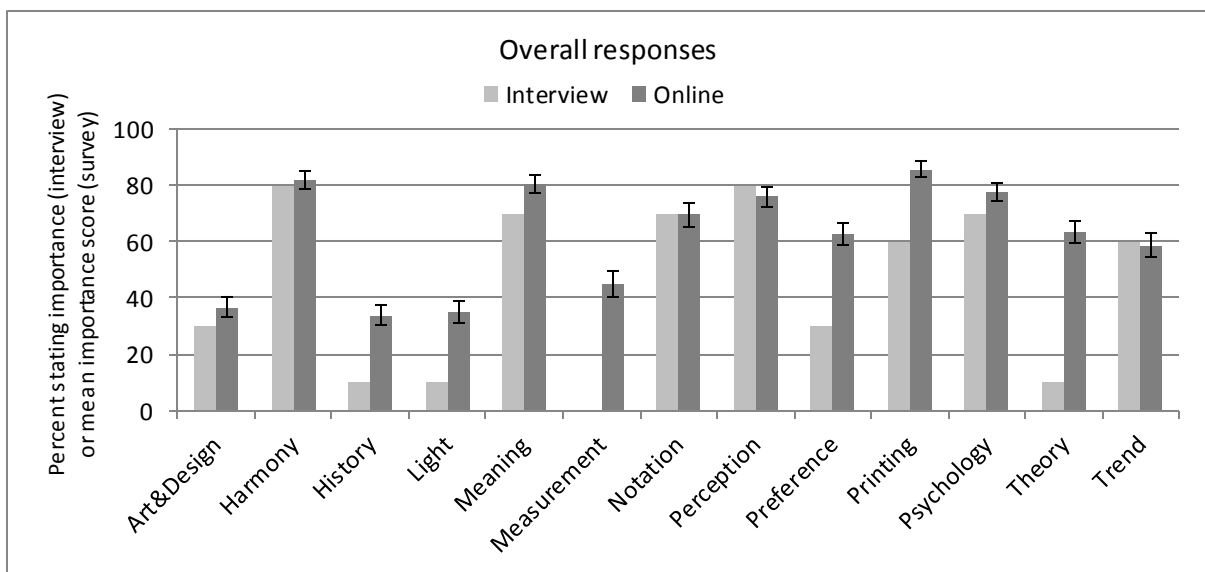
Figure 4.16 The results of face-to-face interviews (light grey) and online surveys (dark grey)
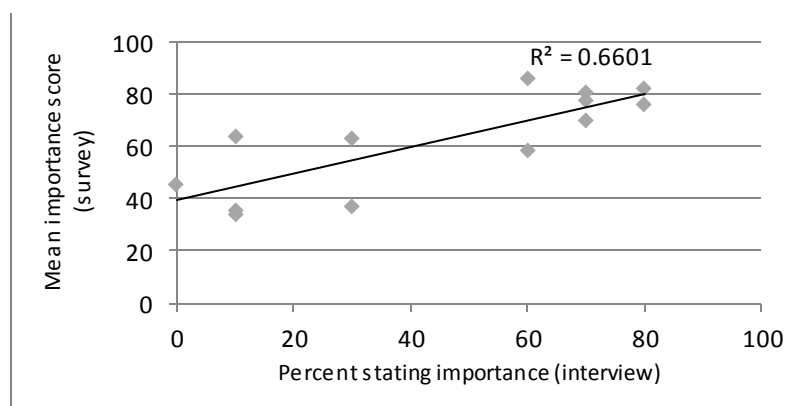
Figure 4.17 Correlation between face-to-face interviews and

online survey results for each information type

4.7 Discussion

This section discusses the results in the order of the research questions. After that, the implications are used to shed light on three issues, which will be investigated in the subsequent chapters. The first issue is concerned with exploring the relationship between colour meaning and context, and this will be explored in Chapter 5. The second issue is regarding which colour meanings are communicated by a product category. A colour meaning framework will be established in Chapter 6, and a colour meaning case study will be conducted in Chapter 7. The third issue is a prototype development of a web-based colour tool, and this will be considered in Chapter 8. Finally, the limitations of the data collection and the analysis methods employed for this chapter are discussed.

4.7.1 Reflection on the results of the research questions

As indicated in Chapter 1, seven research questions were formulated for this thesis. In this section, the results and findings regarding research questions one to four out of the seven are discussed. The four research questions covered in this chapter are as follows:

RQ1. Which colour information is useful in packaging?

RQ2. Why is a particular type of colour information useful?

RQ3. What colour information is used by designers and brand managers?

RQ4. What are designers' and brand managers' suggestions and preferences in terms of a useful colour information tool?

These research questions were approached using interviews and an online survey study in this chapter. The interview was conducted to collect mainly qualitative data to answer the four questions. The online survey gathered quantitative data and was carried out to support the outcome of the interview data for the first research question. The key findings from both studies can be summed up in the following points (Table 4.12).

Table 4.12 Summary of the findings from the interviews and the online surveys

Colour decision

- Through understanding a brand, market, and audience

Types of useful colour information

- Harmony, perception, meaning, psychology, and printing

Reasons of useful colour information

- Colour harmony: Intuition

- Colour perception: To stand out

- Colour meaning: To convey messages

- Colour psychology: To create a response

- Colour printing: For the end result

Current use of colour information

- Very limited, relying on a colour matching system

- Source: Mostly self searching or from clients directly

- Satisfaction: Mostly unaware of

- Role: Strong back up for their colour choice, quick, easy, and informed decision,

  breaking a category norm or new trial, and better understanding of colour

Preferences for existing colour tool types and data types

- Tool type: Website

- Data type: Colour palette, picture, and video

Suggestions for a colour tool

- Colour meaning or predominant colour by product categories

- Colour insight or learning

- Colour combinations

- CMYK, RGB, NCS and Pantone code

- Which colour attract attention

- Colour trend

- Individuals' response

- Researched

- Device to match colour from design to print or identify colour on the product

- Regularly updated

- Community site

- Colour psychology

- Inspiring website

4.7.1.1 Research question 1

• RQ1: Which colour information is useful in packaging?

The first research question seeks to identify useful colour information for designers and brand managers in packaging and branding. Prior to addressing this question, an investigation of what types of colour information exist in the literature was necessary as a preliminary step. Through an analysis of the relevant literature, 13 types of colour information were outlined in Chapter 2: colour in art and design, harmony, history, light, meaning, measurement, notation, perception, preference, printing, psychology, theory, and trend (in alphabetical order). Using these 13 types of colour information, interviews and an online survey were both conducted. For the interview sessions, 10 senior designers and brand managers were interviewed in person for the selection regarding the most useful types of colour information. For the online survey, 62 responses from designers, brand managers, and researchers were collected. In the online survey, in order to explore whether there was any significant difference in the use of colour information types between the three groups (designers, brand managers, and researchers), a one-way ANOVA test was conducted. One unexpected result was that there were 'no significant differences' between the three groups. Therefore, the overall responses from the interviews and the online surveys were compared to draw a conclusion. The average of the per cent stating importance from the interview and the mean importance scores from the online survey were calculated.

The findings from the interviews and the online surveys revealed that *harmony*, *perception*, *meaning*, *psychology,* and *printing* were important in packaging.

4.7.1.2 Research question 2

• RQ2: Why is a particular type of colour information useful?

The second question investigates the reasons concerning the types of colour information that were stated to be important by the interviewees. The results indicated that harmony is intuitive; perception is to stand out; meaning is to convey messages; psychology is to create responses; and printing is for the end result.

One unanticipated outcome was the response for harmony. When interviewees were asked why harmony is important, they did not provide specific reasons. Rather, they cited that "harmony is intuitive" (Interviewees A, E, I and J). As mentioned in the literature review (Section 2.5.1.5), intuition is tacit knowledge acquired by personal experience and not expressed openly, while explicit knowledge is documented, systematic, and described using formal language.

The results for perception, meaning, and psychology support the relative importance of colour information related to consumers' responses regarding colour. For example, which colour attracts consumers' attention? What messages are communicated and transmitted to consumers using colour? What dimensions do consumers experience through colour? Thus, the results support the significance of providing better systematic colour information related these three types of colour information since it is impossible to anticipate all questions relating to the perception, meaning, and psychology depending on the designers' and brand managers' intuition or experience.

Lastly, for printing, participants reported that "printing is the end result" (Interviewees A, D, I, and J) and "printing is a practical point of view" (Interviewee H). This means that printing itself is a design outcome; thus, it appears that information including how to realise a high quality of colour printing is significant. Presumably, practical printing information relating to inks and papers would be useful.

Additionally, another unexpected outcome was the insignificant value of the other eight types of colour information among the 13 except the above five: art and design, history, light, measurement, notation, preference, theory, and trend. It was expected that art and design, preference, and trend may be perceived as important by design professionals. However, participants reported that "art and design is just a starting point in design" (Interviewee H), and "preference keeps changing" (Interviewees A, C, E, and H). Moreover, many negative responses were reported for trend; participants stated "I can predict colour" (Interviewee E), and "It is only marketing and is unethical" (Interviewee G).

To sum up, the results suggest that designers and brand managers use harmony and printing in more practical ways, relying on intuition or focusing on realising the best quality of design outcome. On the other hand, consumers' responses on perception, meaning and psychology cannot be achieved by depending solely on intuition or experience. In this sense, it appears that systematic and documented colour information could be necessary.

4.7.1.3 Research question 3

• RQ3: What colour information is used by designers and brand managers?

The third research question seeks an answer about what type of colour information is used by design professionals. The results showed that only one colour matching system (Pantone) is being used, and current colour information is obtained by self searching or from the clients' brief. For the satisfaction of the existing colour information, the majority of the participants reported that "I am not aware of any" (Interviewees B, D, E, and I). However, a strong demand was reported if the quality of the colour information was perceived as valuable for a strong back up when they communicate with clients, for making informed decisions, when breaking a category norm, and when looking for better insight. Hence, these results suggest that current colour information is not effectively used by users, although there is a strong demand for using it. Accordingly, the problems of the current use of colour information can be concluded with two points: minimal use of colour information and a gap between 'what they use' and 'what they need'.

There was a clear lack of use of colour information. When asked whether interviewees used relevant colour information related to the five types of colour information (harmony, perception, meaning, psychology, and printing) they chose, the majority of them hardly mentioned any formal sources or existing tools. Their current use of colour resources was limited mainly to using the colour matching system. It may be assumed that the minimal use of colour information is because design knowledge is largely tacit, relying on personal experience or intuition rather than using formal documented information (Wong & Radcliffe, 2000). For example, designers know which colours are harmonious almost automatically through their knowledge acquired from experience or

by their intuition. However, Smith (2001) argued that combining tacit and explicit knowledge, such as using both experience or skills and databases together, is synergetic. For example, interviewees might discuss with their clients 'what' colour they chose intuitively, but the intuitively chosen colour cannot cover the 'why question' for their colour choice that links to a strategic or creative use of colour. If there were a good quality of resources or databases for strong back up, communication with clients might be more persuasive. Therefore, to create a successful design or brand, it is suggested that the use of tacit and explicit knowledge needs to be balanced and must take advantage of both.

The limited use of colour information also indicates that there is a noticeable difference between 'what they use' and 'what they need' in current colour information. In other words, they reported that harmony, perception, meaning, and psychology were important, but they are not widely using these types. This lack of use could be due to the fact that people who have tacit knowledge know something so well that at times they do not recognise what is necessary to complete their task successfully (Smith, 2001). The gap caused by the limited use of colour information could result in many designs being generated without the benefit of information.

4.7.1.4 Research question 4

• RQ4: What are designers' and brand managers' preferences and suggestions in terms of a useful colour information tool?

The fourth research question seeks an answer about what types of colour tools are most preferred and suggestions for a colour tool. Four types of colour tools and six types of data types were presented to participants to determine their preferences. Each tool received both positive and negative comments, and the suggestions for a colour tool varied. Conclusions can be drawn based on the responses regarding the most and least preferred tools. Websites received the highest responses and were chosen by 80% (N=8) of all interviewees (N=10), whereas mobile apps received the lowest responses and were selected by only 10% (N=1) of the overall. Comments such as "I do a majority of my work from my laptop, and my mobile is more for personal use" (Interviewee B) were common amongst the interviewees. There were also positive comments, such as

responsive and sharable, but negative comments, such as unreliable. Additionally, preferences on the data type were collected. The most preferred data type was colour palette, which was selected by 70% (N=7) of participants, while statistics and charts received the lowest responses and were chosen by a mere 20% (N=2). Participants stated that they preferred features such as being visual, inspiring, and easy, while textual and technical features were considered unsatisfactory.

Various ideas for a colour tool were suggested: colour community site, colour meaning, individuals' response, predominant colour, researched information, colour trend, combinations, and psychology. On the other hand, other ideas, such as developing a new colour device, were questioned in terms of the feasibility in this study. Although the suggestions were varied, a majority of the interviewees reported that they would like to know more about the colour meaning or the predominant colour by product categories.

4.7.2 Investigation of colour meaning and context

The result of the interviews and the online surveys in this chapter related to RQ1 (Section 4.7.1.1) indicated that colour meaning provides both important and useful information for design professionals. Moreover, the results of interviewees' suggestions for a colour tool related to RQ4 (Section 4.7.1.4) revealed that information on 'colour meaning or predominant colour in product categories' would be considerably useful. However, a critical question is whether colour meanings are affected by context (e.g. product categories), and this topic is still a controversial issue in colour research. It appears that colour meaning is at least or even largely influenced by the product categories to which the colour is applied. However, different studies have reported different results for the meaning regarding the context in which colours are applied. In addition, there has been little study on brand packaging colour. It seems that the different results can be attributed to the use of different scales and different product categories. Thus, before applying a suggestion to a tool development study (Chapter 8) directly, it appears that it is of great importance to reconsider the question of whether colour meanings are independent of or dependent upon product categories within packaging and branding. This idea will be explored through an empirical colour survey in Chapter 5.

4.7.3 Building a colour meaning framework

The implication for RQ2 regarding why a particular type of colour information is useful (Section 4.7.1.2) provided the notion that perception, meaning, and psychology are closely related to consumers' perspectives on colour. Furthermore, an extensive body of literature claimed that brand packaging colours are critical for product and brand communication. Thus, in order to provide an understanding of what colour meanings are communicated in a product category, a colour-meaning framework is to be established that integrates both practice (existing colour strategies) and semiotic theories in Chapter 6.

4.7.4 Conducting a colour meaning case study

In order to gain depth insight on colour meanings in a product category, a colour meaning case study is to be conducted focusing on washing-up liquid packaging in Chapter 7. In the case study, in which consumers will participate in interviews and an online survey, important factors will be identified regarding consumer decisions when they buy washing-up liquids; possible packaging colours will also be suggested. After that, the outcome will be reviewed by a brand manager from a leading consumer goods manufacturing company.

4.7.5 Need for a colour information tool

The findings of the current use of colour information related to RQ3 (Section 4.7.1.3) shed light on the attention to a key problem of current colour information being used by professionals. The identified problem was that there is a gap between 'what users use' and 'what users need'. In other words, colour information as currently included in present resources or tools is incapable of linking between users and useful colour sources. In response to such a noticeable gap, it is necessary to attempt to develop a colour tool that could serve useful and offer a better quality of colour information. Furthermore, an analysis of interviewees' preferences for a colour tool showed that a website is the most preferred tool type. Thus, a web-based colour tool based upon interviewees' suggestions could provide a solution to diminish the gap between the current use of colour information and users' needs. Chapter 8 will describe the

development process of the web-based prototype developed by the researcher. Based on the results of the colour information study in this chapter, a few recommendations for the colour information tool are suggested:

- Offer the potential for the content to be presented in a useful manner for design information users and in a highly visual way, focusing on harmony, perception, meaning, psychology, and printing.
- Enable design professionals to access it easily in their daily practice as a web-based tool.
- Be capable of dealing with various users' preferences and suggestions.
- Provide an opportunity for both tacit and explicit colour information to be balanced.

4.7.6 Critique of the research methods

The face-to-face interview was adopted as the primary data collection method to conduct an in-depth investigation of the useful colour information in packaging and branding. As no data gathering technique can be perfect, face-to-face interviews have certain limitations. Generally, one of the disadvantages is that the interviewer's visibility can influence the interviewees' responses in a certain direction, which may produce biases. In order to diminish these limitations, an interview protocol was used (Opdenakke, 2006). In addition, pilot interviews were held with two PhD students in order to test the quality of the interview protocol and for identifying potential researcher biases.

Another problem that may not be prevented by the use of face-to-face interviews is the quality of data generated from interviewees. As the data are obtained from the interviewees' own experiences, the results may provide only partial views if a researcher only uses face-to-face interviews. In order to minimise this limitation, a web-based survey was conducted to support the interview findings.

Regarding the qualitative data analysis of the interview, an inherent limitation is that data can be biased as the researcher decides which aspects are important. In order to

diminish researcher bias and over-analysis, an uninvolved researcher (a PhD student at Leeds University) reviewed the codes and themes (Creswell, 1998; Turner, 2010).

In terms of the online survey, the biggest advantage is its fast distribution and high response rate in a short time (Cobanoglu *et al.*, 2001; Roztocki, 2001). Although the web-based survey is known to be an effective method, there may be some potential problems, such as multiple responses from the same participant, incomplete responses, and responses from unintended participants (Roztocki, 2001). Using online survey software (QuestionPro), these limitations of the web-based survey were prevented by checking IP numbers to identify multiple submissions from the same participant and deleting incomplete responses. To control the eligibility of participants and access to only the intended participants, LinkedIn was used to post a survey to relevant professional groups in the packaging and branding fields. This selection allowed only LinkedIn group members to participate the survey, which meant the survey participants were controlled to some extent.

The comparative analysis of the interviews and the online surveys in Section 4.6 was problematic because the interview was 'binary' while the online survey provided 'interval' data. In order to produce a common base, the percentages were calculated for the interview and then compared to the mean importance score for the online survey. This analysis may be refuted due to the fact that it cannot be compared and the result is therefore unreliable. However, upon examination of the results of the interviews and the online surveys, there was a similar pattern, although the order was slightly different. For the interviews, the order of importance stated by 10 interviewees was harmony, perception, meaning, psychology, and printing (chosen by more than 6 participants out of 10). In the online survey, the order of importance according to 62 participants was printing, harmony, meaning, psychology, and perception (greater than 70). Thus, it can be concluded that the results of the online survey corroborate the results of the interview.

4.8 Conclusions

4.8.1 Key insights

The goal of this chapter was to develop an understanding of the characteristics of useful colour information before developing a tool for supporting design professionals. This insight will be utilised at the prototype development stage in Chapter 8.

According to the key findings in this chapter, harmony, perception, meaning, psychology, and printing are arguably useful for designers and brand managers in packaging and branding. The specific reasons for the relative importance of the five types of colour information are intuition (harmony), to stand out (perception), to convey the proper messages (meaning), to create a consumer response (psychology), and a direct relationship to the design outcome (printing). Moreover, the research discovered that both tacit and explicit colour information are demanded from design professionals for strong back up, making informed decisions, breaking a generic colour code, and gaining insight. In particular, perception, meaning, and psychology are considered to be significant in capturing consumers' thinking by engaging with the packaging and brand colours. However, current colour information analysis indicated that colour information is not used effectively by users and that a colour matching system is only employed for printing. Any formal use of colour information concerning harmony, perception, meaning, and psychology was not reported by the interviewees. In other words, the most obvious problem with the existing colour information types are that there is a gap between 'what users use' and 'what they need'.

In terms of a colour tool, various suggestions and preferences for a colour tool from participants provided potential and initial ideas to be designed in order to bridge the gap between colour information and users. The most preferred colour tool type was a website, and features such as visual, inspiring, and easy were considered satisfactory by all participants. Although designers' and brand managers' suggestions for a colour tool varied and some ideas were questioned in regards to their feasibility for this study, a majority of the suggestions had some similar characteristics, such as colour meaning

and predominant colour in a different context, fruitful, researched, and regularly updated.

The aforementioned situation suggests a potential to support design professionals in the design process and with design strategy by providing better colour information and tools. The achieved insight from this chapter will be applied to web-based colour tool development in Chapter 8. However, before undertaking the colour tool development, it was recognised that additional colour meaning studies are necessary. The first is to explore whether colour meanings are affected by context (Chapter 5), and the second is to build a colour-meaning framework (Chapter 6). The final study should be a colour meaning case study that focuses on washing-up liquid packaging (Chapter 7).

4.8.2 Next step

The next step is to explore whether colour meanings are affected by product categories. Consistencies or inconsistencies will be investigated between chips and object ratings (cosmetics, crisps, hand wash, medicine, toilet tissue, and white wine) for the same colour: RQ4.1.

Chapter 5
COLOUR MEANING EXPERIMENT

Through the interviews and the online surveys, Chapter 4 identified that 'colour meaning' is important colour information for designers and brand managers in packaging and branding. Moreover, one of the suggestions for a colour tool, which were provided by the interviewees, was 'colour meaning in different product categories'. However, empirical colour meaning studies within packaging and branding are rare and little agreement has been reached on whether colour meanings are affected by context i.e. product categories. Thus, this chapter reports on the results of a colour meaning experiment to assess the contextual dependence or independence of the meaning of packaging colours. The insight will be applied to a colour case study (Chapter 7) and a prototype development of a colour-meaning-centred website (CMCW) in Chapter 8.

Before conducting the colour meaning experiment in Chapter 5, in order to select specific colours and bi-polar words for the experiment, a brief analysis of literature was undertaken.

5.1 Introduction

A vastness of colour meaning research has been conducted in various disciplines such as science, design, psychology, marketing, etc. Generally, in colour meaning research, isolated colour chips are widely used as stimuli without consideration of context (i.e. with being placed in the context of a product category, for example) due to the experiments being easy and inexpensive (Taft, 1996). Furthermore, in such research, participants are typically asked to rate the colour chips against bi-polar scales such as warm-cold, masculine-feminine, etc. However, ignoring the effect of context has been criticised mostly by experimental psychologists. Whitfield and Whiltshire (1990) criticised the absence of the context in the prior colour research and argued that the research has little value due to the methodological shortcomings. Crozier (1996) also

highlighted the importance of contextualising judgements in colour research. Recent research has started to explore the relationship between colour meanings of colour chips and real-world objects. However, different research has produced different results. Taft (1996) attested that there were no significant differences between semantic ratings on colour chips and contextual colours. On the other hand, more recently, in interior architecture design, Ural and Yilmazer (2009) compared four situations such as isolated colour chips, abstract composition, 2D drawings and a simulated 3D interior space, and showed that the colour meanings do depend upon context.

In packaging and branding, colour meaning plays a significant role as a communicator, conveying product and brand meanings, as highlighted in Section 2.4.2.2. However, empirical studies on the relationship between brand packaging colour and context are rare and theoretical colour knowledge arises from the prior studies mostly without the consideration of the context (Ural & Yilmazer, 2009). Moreover, choosing isolated colour samples from design resources and then applying these decisions to real design outcome is widely used approach by design professionals (Taft, 1996; Ural & Yilmazer, 2009). However, many design resources present colour meaning information without consideration of the context. Figure 5.1 presents one of examples of colour meaning information appearing on current colour websites.
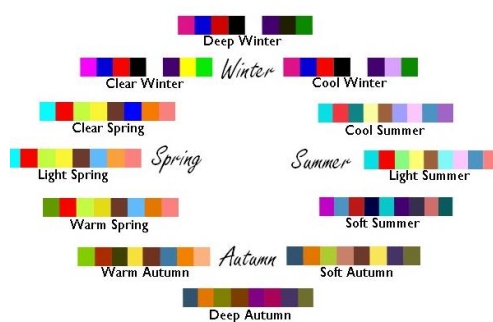
Figure 5.1 Typical colour meaning information in websites

A critical question is whether it is appropriate to use the colour meaning resources

derived from prior research or references without the consideration of the specific context. The lack of accurate information on colour meaning in packaging and branding could cause inappropriate colour choices and strategic failure such as miscommunication with customers. Moreover, the need for more research has been suggested in marketing (Kauppinen-Räisänen, 2010). Thus, it appears that it is inevitable to reconsider the question of whether colour meanings are independent or dependent of context within packaging and branding.

This chapter consists of six sections. Section 5.1 summarises why and how the colour meaning experiment was carried out in this chapter. Section 5.2 presents the aim and objectives of this chapter. Section 5.3 describes how specific colour stimuli and bi-polar words were selected including participant recruitment, experiment process and methods used for data analysis. Section 5.4 illustrates the results of parts A and B for the experiment. Section 5.5 discusses the key findings and study limitations of this chapter. Sections 5.6 outline conclusions and introduce the next steps.

5.2 Aim and objectives

A specific research question (RQ4.1 of this thesis) was addressed by this chapter. The aim of the chapter was therefore to examine whether colour meanings are affected by context within brand packaging, and the following objectives enumerated to achieve the aim. In this chapter, the term 'chip meaning' and 'context meaning' are used for convenience. Chip meaning refers to the associated meanings when only isolated colour chips were evaluated while context meaning refers to colour meanings evaluated when colours were applied to a variety of product categories.

1. To explore whether there are any significant differences between chip meaning and context meaning (using simplified packaging images).
2. To explore whether there are any significant differences between chip meaning and context meaning (using real brand packaging images).

5.3 Experimental configuration

The following sections describe the selection and justification for the scale type, colours and bi-polar words used in this colour meaning experiment.

5.3.1 Measuring method and scale type

This chapter adopts a semantic differential-based method using a direct magnitude scale to measure people's thinking on colour stimuli with and without context. Semantic differential (SD) is the most widely used measurement technique to assess people's subjective thinking and feeling in social and marketing research (Diamantopoulos & Schlegelmilch, 2000; Robson, 2011). This self-completed rating technique was introduced in a book titled *The Measurement of Meaning* written by psychologist Charles Osgood and his colleagues (1957). Central of the method is assessing the subjective meaning of a concept using bi-polar adjective pairs (e.g. warm-cold) as an index of perceived meaning. The term bi-polar is defined as having opposite poles (Oxford English Dictionary, 2015). Typically, participants are asked to place a cross (Type 1) or circle a number (Type 2) on a scale between two bi-polar words as shown in Figure 5.2 (Jayne, 1996). And the SD spaces between the two opposite words are assumed to be an interval scale (Heise, 1969). One advantage of this rating type is that it forces participants to concentrate on the provided criteria (Jayne, 1996). Another advantage is that it is relatively easy for researchers to implement and for participants to make a judgement as to where to place an X (or circle a number) on a scale that best describes their opinion (Mindak, 1961).

Type 1: Educated _____ _____ ___<u>X</u>___ _____ _____ _____ _____ Uneducated

Type 2: Educated   1   2   3   4   5   6   7   Uneducated
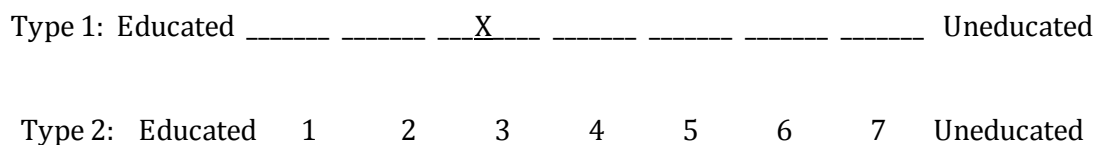
Figure 5.2 Types of a SD scale (Jayne, 1996)

The next decision is how many points of choice should be used on a scale. Osgood *et al.* (1957) originally adopted a seven-interval scale allowing participants to place an X on a scale like that shown in Figure 5.2. Although scales with more than seven intervals may

elicit more sophisticated responses, it is considered inappropriate since the task would become complicated and boring for participants. However, the seven-interval scale could have a limitation which may limit subsequent statistical analysis (Jayne, 1996). In order to maximise the advantage and minimise the disadvantage of the SD scale, this chapter adopted a direct magnitude scale using a slide bar in which participants are asked to quantify a specific number on a scale of 0-100. This decision was made since it would have been very complex and endless in rating 54 images repeating five bi-polar words pairs for each image. Participants were presented with slider bars which could be used to indicate their opinion (see Figure 5.3 for example). For subsequent analysis the left-most position was denoted zero and the right-most position was denoted 100 (with the central position being denoted as 50). However, all that is important for the participants is that they understood that the slider bar represented a linear scale between the two terms at each end.
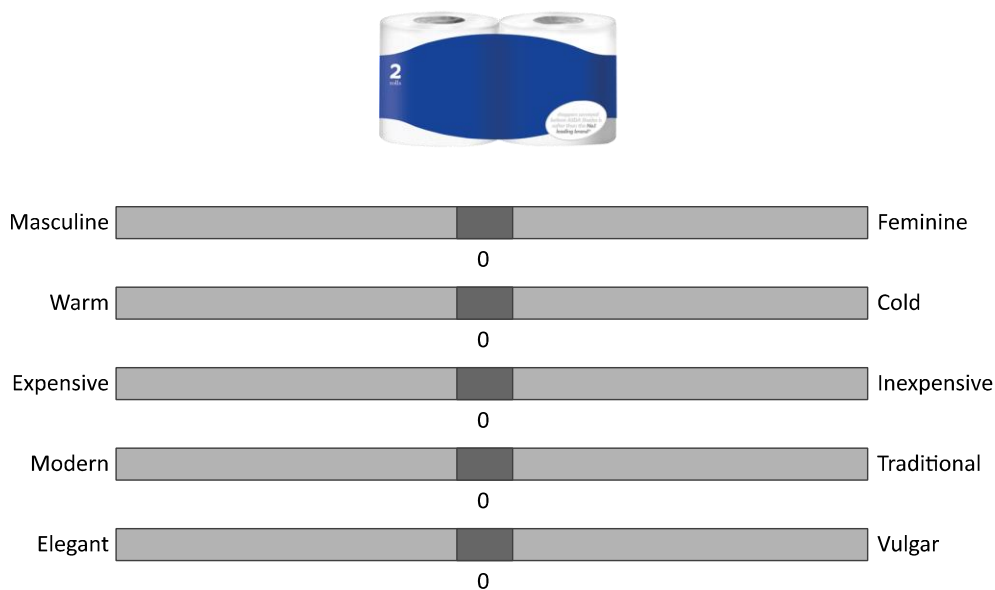
Figure 5.3 A SD based-scale used for this chapter

5.3.2 Selection of colour stimuli and bi-polar words

In this chapter, six colours were selected for study: beige, black, blue, green, red and yellow. In some sense, the choice of colours is arbitrary since it is the difference between chip meaning and context meaning that is the focus of the study, and it is simply sufficient to include a variety of colours to test that. However, some thought was

put into which colours should be used. Beige was selected as saturated colours are preferred to unsaturated colours in general (Smets, 1982); black, blue, green and red were selected since they are often popular colours across cultures (Eysneck, 1941; Grieve, 1991); yellow was chosen because it has been widely used for global brands such as Kodak, McDonald's, Master Card, Nikon, etc. although it is the least popular colour (Eysneck, 1941).

In selecting bi-polar words, Jayne (1996) suggested considering relevance to the study in order to obtain meaningful data rather than using a set of words that sound simply appropriate. The brief review of the relevant literature on colour meaning (mostly chip meaning) corresponding to the six colours is as follows:

Colour beige

The colour beige is perceived as kindness, weakness, sickness, obedience (Grieve, 1991) and expensive (Kerfoot *et al.*, 2003), and this colour is belongs to a low chromatic colour group (Grieve, 1991). In general, it is argued that saturation is more important for colour preference than either brightness or hue (Smets, 1982).

Colour black

Black tends to have colour meanings such as sad and stale across cultures (Madden *et al.*, 2000). Moreover, the colour black is generally associated with fear, anger, powerful (Grieve, 1991; Aslam, 2006) and death (Grieve, 1991). In addition, it is perceived as expensive in Korea, China and Japan (Aslam, 2006), and old, dignity and hi-tech in some countries such as UK and Taiwan (Grimes & Doole, 1998).

Colour blue

The colour blue is the most preferred colour cross cultures (Eysneck, 1941; Paul & Okan, 2010), and is perceived as calming, peaceful (Madden *et al.*, 2000), reliable, thoughtful, expensive, serious and male (Grimes & Doole, 1998). Also, it communicates unique meanings in different countries; interestingly, warmth in the Netherlands; coldness in Sweden; death in Iran and purity in India (Paul & Okan, 2010).

Colour Green

Green is generally associated with reliable, safe, fresh, natural, environment (Grimes & Doole, 1998), peaceful and gentle (Madden *et al.*, 2000) across cultures but also with health (Kauppinen-Räisänen, 2014). In addition, in some countries, the colour green is associated with inexpensive, traditional, and beautiful (Grimes and Doole, 1998).

Colour red

The colour red is generally associated with warm (Paul & Okan, 2010) and excitement (Hynes, 2009). It also has connotations as hot and active cross countries (Madden *et al.*, 2000); and it is preferred across countries (Eysneck, 1941). It is also associated with expensive and premium across cultures (Grimes & Doole, 1998).

Colour yellow

Yellow typically belongs to the set of warm colours (Grimes & Doole, 1998; Hynes, 2009). The colour yellow is associated with both positive and negative meanings. Yellow is associated with playful, expensive and luxury (Grimes & Doole, 1998). On the other hand, it is associated with sorrow, despair and jealous in some countries (Aslam, 2006; Paul & Okan, 2010) and it is less preferred across countries (Eysneck, 1941).

Based on the above colour meanings and the relevance for the chosen objects for this chapter (cosmetics, crisps, toilet tissue, hand wash, medicine and white wine), five words such as male, warm, expensive, traditional and luxury were initially chosen. For example, colour beige is perceived as kindness. However, it was considered that kindness was no relevant value for the chosen six objects. Hence, kindness was not used. Some of words such as male and luxury were changed to synonyms like masculine and elegant and the relevant opposite words were chosen according to Oxford English Dictionary. Finally, the selected five bi-polar words for this chapter are masculine-feminine, warm-cold, expensive-inexpensive, modern-traditional and elegant-vulgar. Table 5.1 summarises the colour meanings for the beige, black, blue, green, red and yellow, and the chosen words were marked with grey.

Table 5.1 Colour meanings for colour beige, black, blue, green, red and yellow

Colour	Meanings	References
Beige	kindness	Grieve, 1991
	weakness	Grieve, 1991
	sickness	Grieve, 1991
	obedience	Grieve, 1991
	expensive	Kerfoot *et al.*, 2003
Black	sad	Madden *et al.*, 2000
	stale	Madden *et al.*, 2000
	fear	Aslam, 2006
	anger	Aslam, 2006
	expensive	Aslam, 2006
	hi-tech	Grimes & Doole, 1998
	death	Grieve, 1991
	old	Grimes & Doole, 1998
	power	Grieve, 1991; Aslam, 2006
	dignity	Grimes & Doole, 1998
Blue	calming	Madden *et al.*, 2000
	thoughtful	Grimes & Doole, 1998
	peaceful	Madden *et al.*, 2000
	reliable	Grimes & Doole, 1998
	expensive	Grimes & Doole, 1998
	male	Grimes & Doole, 1998
	warm	Paul & Okan, 2010
	cold	Paul & Okan, 2010
	death	Paul & Okan, 2010
	purity	Paul & Okan, 2010
	serious	Grimes & Doole, 1998
Green	reliable	Grimes & Doole, 1998; Paul & Okan, 2010
	peaceful	Madden *et al.*, 2000
	gentle	Madden *et al.*, 2000
	beautiful	Madden *et al.*, 2000
	health	Kauppinen-Räisänen, 2014
	traditional	Grimes & Doole, 1998
	inexpensive	Grimes & Doole, 1998
	safe	Grimes & Doole, 1998
	environment	Grimes & Doole, 1998
	fresh	Grimes & Doole, 1998
	natural	Grimes & Doole, 1998
Red	warm	Paul & Okan, 2010
	excitement	Hynes, 2009

	active	Madden *et al.*, 2000
	hot	Madden *et al.*, 2000
	expensive, premium	Grimes & Doole, 1998
Yellow	warm	Grimes & Doole, 1998; Hynes, 2009
	playful	Grimes & Doole, 1998
	expensive	Grimes & Doole, 1998
	luxury	Grimes & Doole, 1998
	sorrow, despair	Paul & Okan, 2010
	jealous	Aslam, 2006; Paul & Okan, 2010

5.3.3 Recruitment of participants

In total, 25 students (male=8 and female=17) between the ages of 26 and 45 in various fields of design, textile, science, education, transportation and medical at Leeds University took part in the study. Participants were screened by asking whether they have colour deficiencies. The Ishihara (1969) colour vision test book was prepared in case there might be some participants who had not taken the test and were not sure about the colour vision problem.

5.3.4 Experiment preparation

Experimental Phases

Two experimental phases were conducted. In part A, simple colour patches and simplified packaging images were used as the stimuli. The simplified packaging images allowed for a controlled experiment where the only variable was colour. However, the work could be criticised because the images were not totally realistic. Therefore, in part B, simple colour patches and real-world packaging images were used as the stimuli. Although the real-world images are realistic, there is usually more than one colour on the packaging and other associated graphics and text that make analysis difficult and robust conclusions almost impossible. However, by using both simplified and real-world packaging images, it may be possible to make reliable conclusions.

Colour stimuli

A set of six colours for part A and another set of six colours for part B were prepared. The colour attributes for parts A and B were in the similar hue range of beige, black, blue, green, red and yellow but not identical. The six colours for part A were chosen in

the colour range of Pantone. The six colours for part B were extracted from the real packaging that was randomly selected from packaging images. The chosen colours were abstracted colour chips (6cm x 6cm) and they were mounted against a light grey (R=G=B=204) background on a MATLAB coded screen. Table 5.2 shows the colour names and Pantone notations used for this chapter. For part A, the Pantone reference is listed for the colours along with the sRGB colour representation. However, for part B (since the colours were extracted from images rather than chosen from the Pantone system) the Pantone notations are not known. However, the sRGB colour representations are listed for both parts A and B so that it is possible to see how different (or similar) the two sets of colours were. Table 5.3 also allows a visual comparison between the two sets of colours. Although the colour stimuli were specified in RGB values, the CIE Yxy values were measured with a spectroradiometer (Minolta CS-100A). The measured Yxy values are provided in Appendix C1 so that other researchers can understand exactly which colours were used in the experiment.

Table 5.2 Colour names and Pantone notations used in part A and part B of the colour meaning experiment

Part A			Part B	
Colour term	Pantone notation	RGB	Colour term	RGB
Beige	7507	255 222 176	Beige	234 197 161
Black	black	0 0 0	Black	0 0 0
Blue	072	20 67 151	Blue	20 110 170
Green	363	32 138 60	Green	0 156 49
Red	1797	198 29 43	Red	197 0 8
Yellow	Yellow	233 239 0	Yellow	248 208 0

Context

The context devised for this experiment was cosmetics, crisps, toilet tissue, hand wash, medicine and white wine. In part A, the six object images were first converted to greyscale in Photoshop, and then each of the object images was colourised to match each of the chosen six colours (beige, black, blue, green, red and yellow). Part B used images of real packaging. In total, 54 images including colour chips and coloured objects were mounted against a light grey background and coded using MATLAB.

Table 5.3 42 images used in part A (from top: colour chips, cosmetics, crisps, toilet tissue, hand wash, medicine and white wine) and 12 images used in part B. Slightly larger versions of the packages from part B are shown in Appendix C2

5.3.5 Experiment process

The experimental protocol is described below:

Setting up. All participants were given both written and verbal instruction (Appendix C3) about the task, and received an informed consent form (Appendix C4). Participants were verbally asked whether they have colour deficiencies. The Ishihara (1969) colour vision test book was prepared in case it might be necessary for participants who had not taken the test.

Venue. A dark experimental room (2m x 2m) was prepared. All participants viewed the images with the same computer in the same room.

Practice and start off. Before engaging with the experiment, participants had a short practice where they rated several images against the five semantic scales to get used to the survey and the dark condition of the experimental room. All participants were easily

adapted to the survey. A total of 54 images with five bi-polar words were then randomly displayed on a 20" computer screen. On average, it took about 30 minutes to complete the task.

5.3.6 Data analysis method

R-squared was calculated to explore relationship between chip meaning and context meaning. R-squared is a commonly used technique to explore how much the two variables are related (Robson, 2011). If, for example, R^2 is 0.18, this means that the proportion of variance indicated is 18%. The coefficient for the scores of chip meaning and context meaning was calculated and tabulated. A paired-sample t-test was employed to explore whether there is any significant difference between chip meaning and context meaning. This is a widely used technique to compare two means (Robson, 2011). Means from chip meaning and from context meaning were tabulated and compared.

5.4 Results

In total, 25 participants took part in the colour meaning experiment, and it included a total of 54 images over five semantic scales. In part A, the participants rated 42 images (six colour chip series and 36 object series corresponding to the six colours) against five semantic scales; the object images used in the part A had been corrected in Photoshop removing graphic elements. In part B, the participants rated 12 images (six colour chip series and six object series) against five semantic scales, and the object images used in the part B were real packaging without any image correction. Analyses were preformed on the data for parts A and B individually. Relationships (R-squared) and differences (t-test) between chip meaning and context meaning were examined.

The key findings can be summarised as follows: 1) the results of part A show that few significant differences (28%) existed between chip meaning and context meaning. The differences were found in a number of colours, objects and semantic scales i.e. red and black; hand wash and medicine; and masculine-feminine and elegant-vulgar; 2) the results of part B show that more significant differences (43%) existed between chip

meaning and context meaning; and 3) the comparison of parts A and B shows 13% differences respectively between chip meanings of parts A and B and context meanings of parts A and B.

5.4.1 R-squared (Part A)

Figures 5.4, 5.5, 5.6, 5.7 and 5.8 present the results from part A for masculine-feminine, warm-cold, expensive-inexpensive, modern-traditional and elegant-vulgar respectively. In each figure, data are separately shown for each of the six packaging contexts. On the left-hand, there is a bar chart showing the semantic scores (chip meaning and context meaning) for each of the six colours. On the right-hand side, chip meanings are plotted against context meanings and the correlation is indicated. For example, it is evident from the first row of Figure 5.4 that beige, red and yellow are judged as quite feminine as both chip colour and context colour (in the case of cosmetics) and this is reflected by a high correlation coefficient ($R^2 = 0.99$).

In Table 5.4 the correlation coefficients are summarised. Correlation values higher than 0.8 are marked with light grey colour and those lower than 0.2 are marked with dark grey colour to make visual inspection of the results easier.

Generally, if the figures and table are considered, the correlation between chip meaning and context meaning is quite high; this implies quite a strong relationship between the chip meaning and the context meaning for the different colours. However, there are some notable differences, e.g. medicine and hand wash etc. The warm-cold scale is the one where there is consistently very high correlation between chip meaning and context meaning (Table 5.4). Masculine-feminine also shows particularly high correlation in every case with the exception of the medicine context. Arguably, modern-traditional shows the greatest variance with high correlation in the case of cosmetics and toilet tissue, much lower correlation in the case of crisps and medicine, and almost no correlation in the case of hand wash.

Also, it is important to note that if two things have a high correlation that is not necessarily the same as those two things being the same as (though in many case it is

the same thing). For example, considering the cosmetic context (Figure 5.4) although there is a high correlation, the colours are generally judged to be a little more feminine for context meaning rather than for chip meaning.

An additional analysis is the t-test which will specifically test to see whether the context meanings and chip meanings are the same or not.
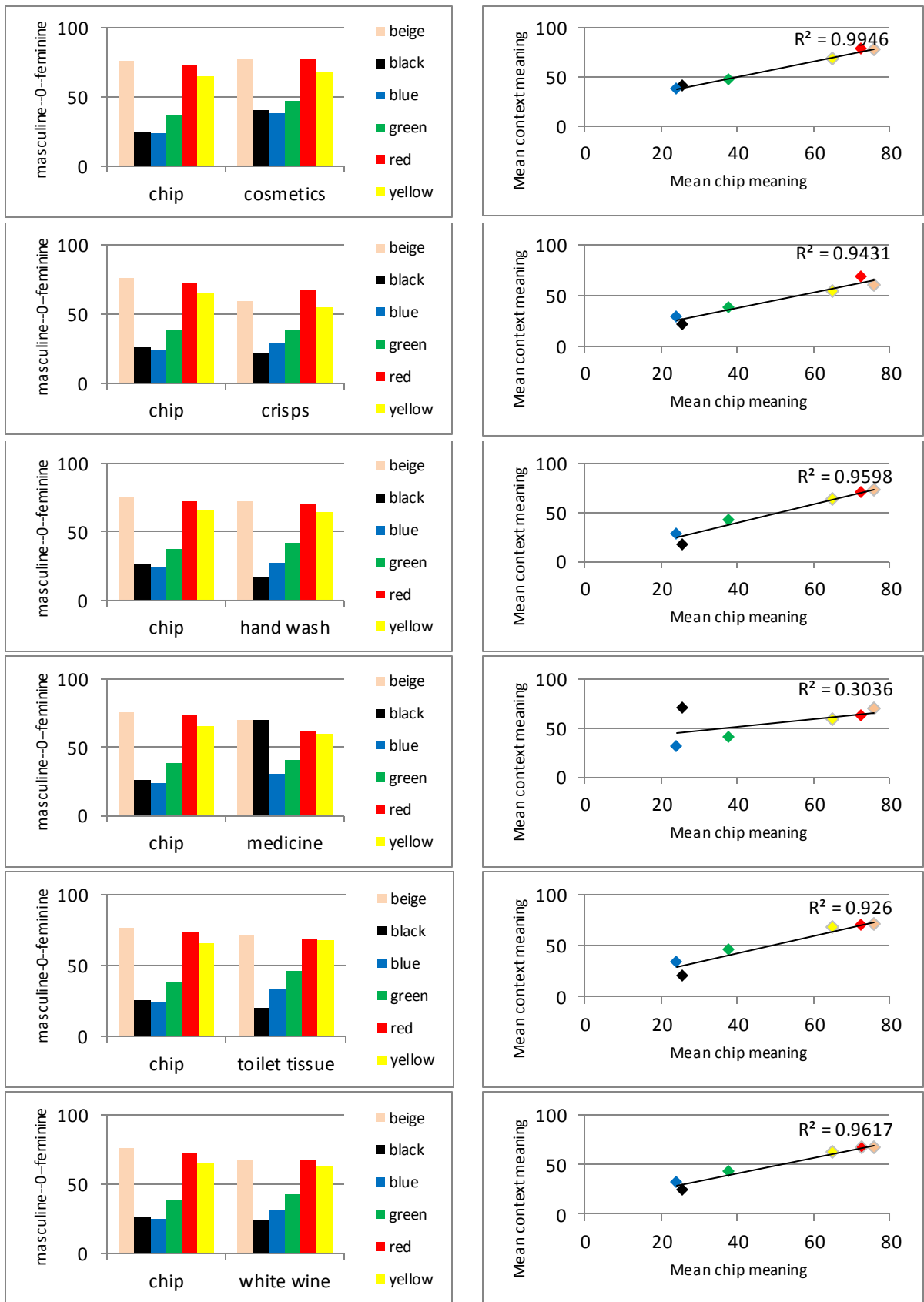
Figure 5.4 Mean and R-squared of chip and context meaning for masculine-feminine
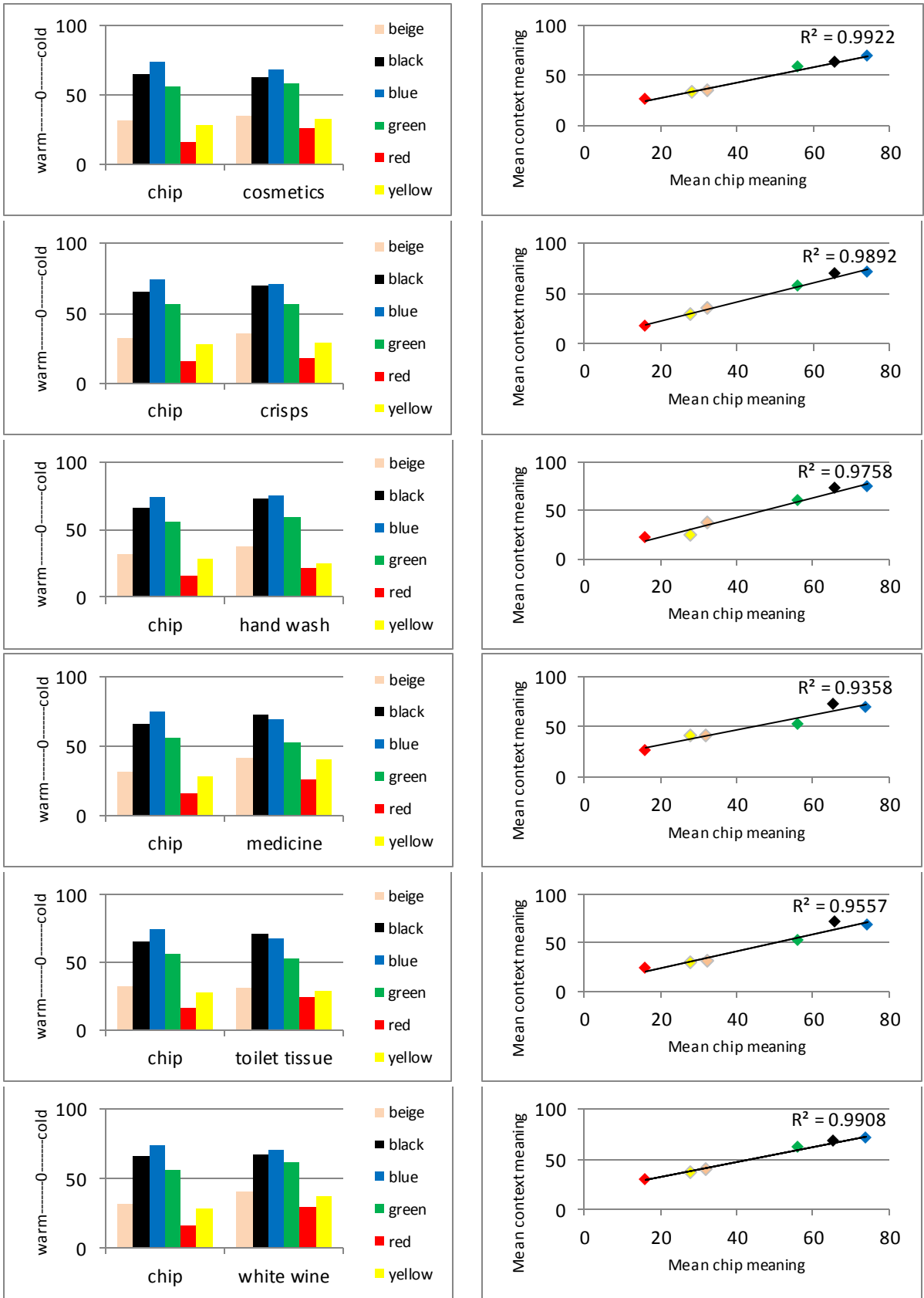
Figure 5.5 Mean and R-squared of chip and context meaning for warm-cold

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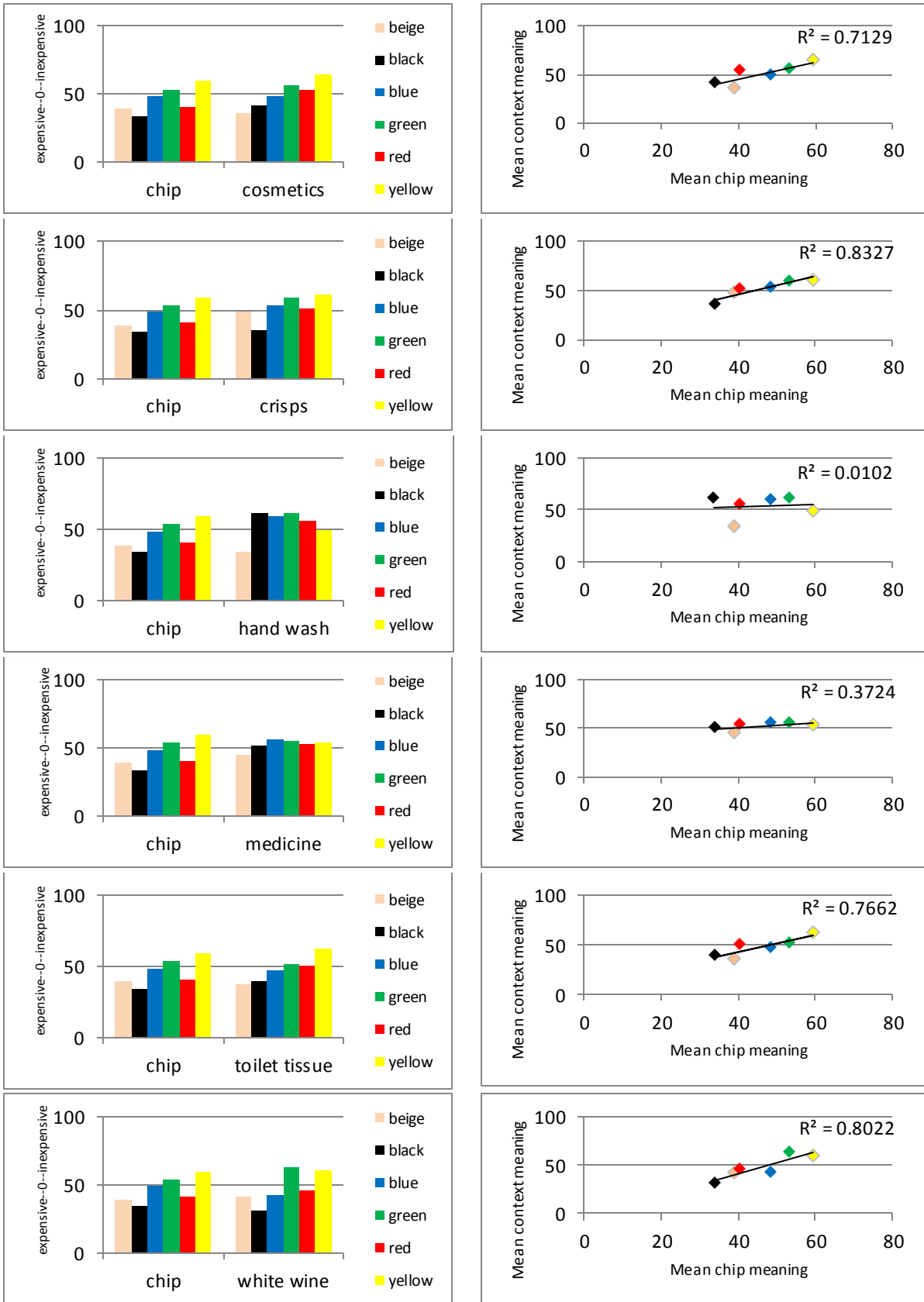
Figure 5.6 Mean and R-squared of chip and context meaning for expensive-inexpensive
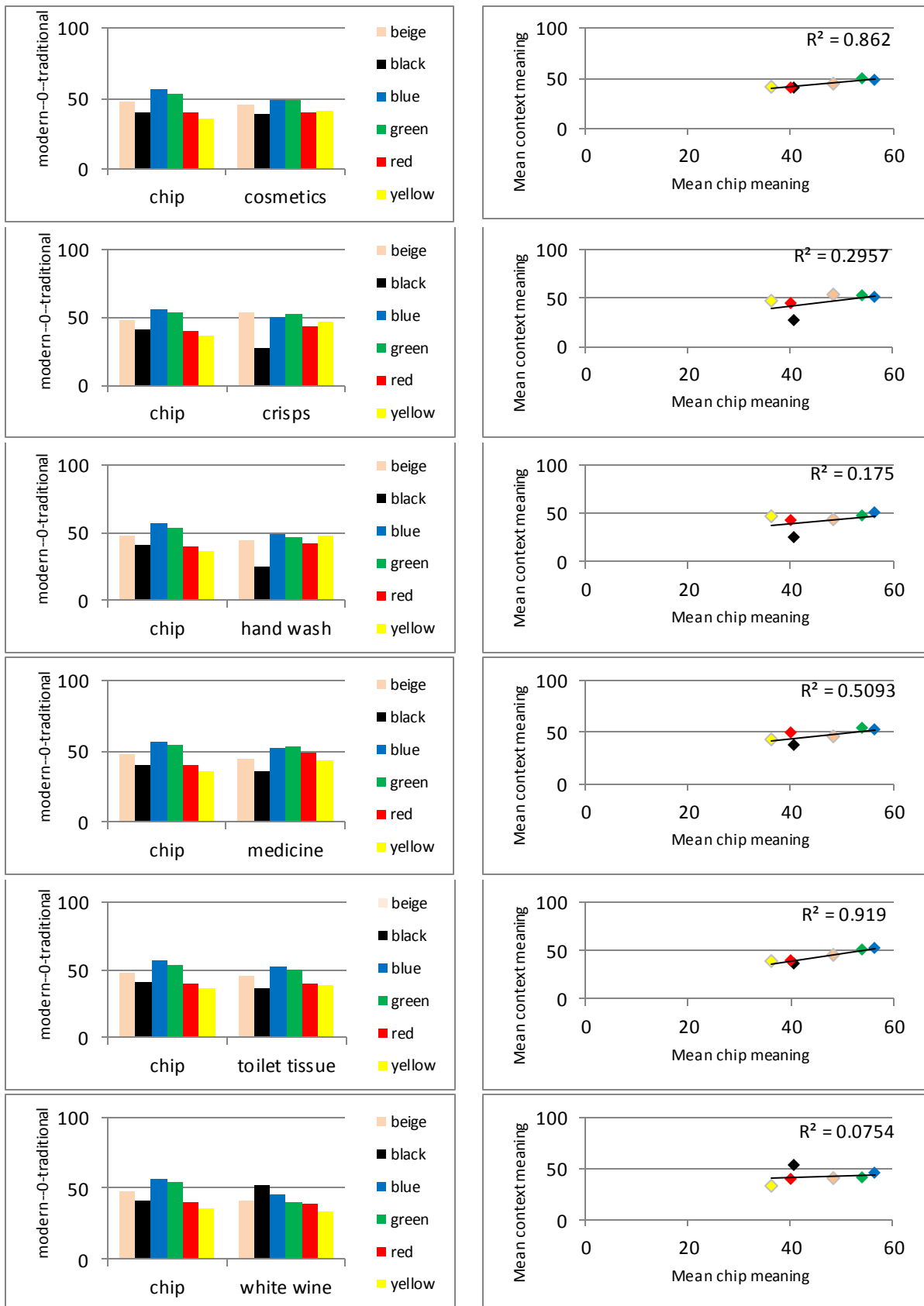
Figure 5.7 Mean and R-squared of chip and context meaning for modern-traditional
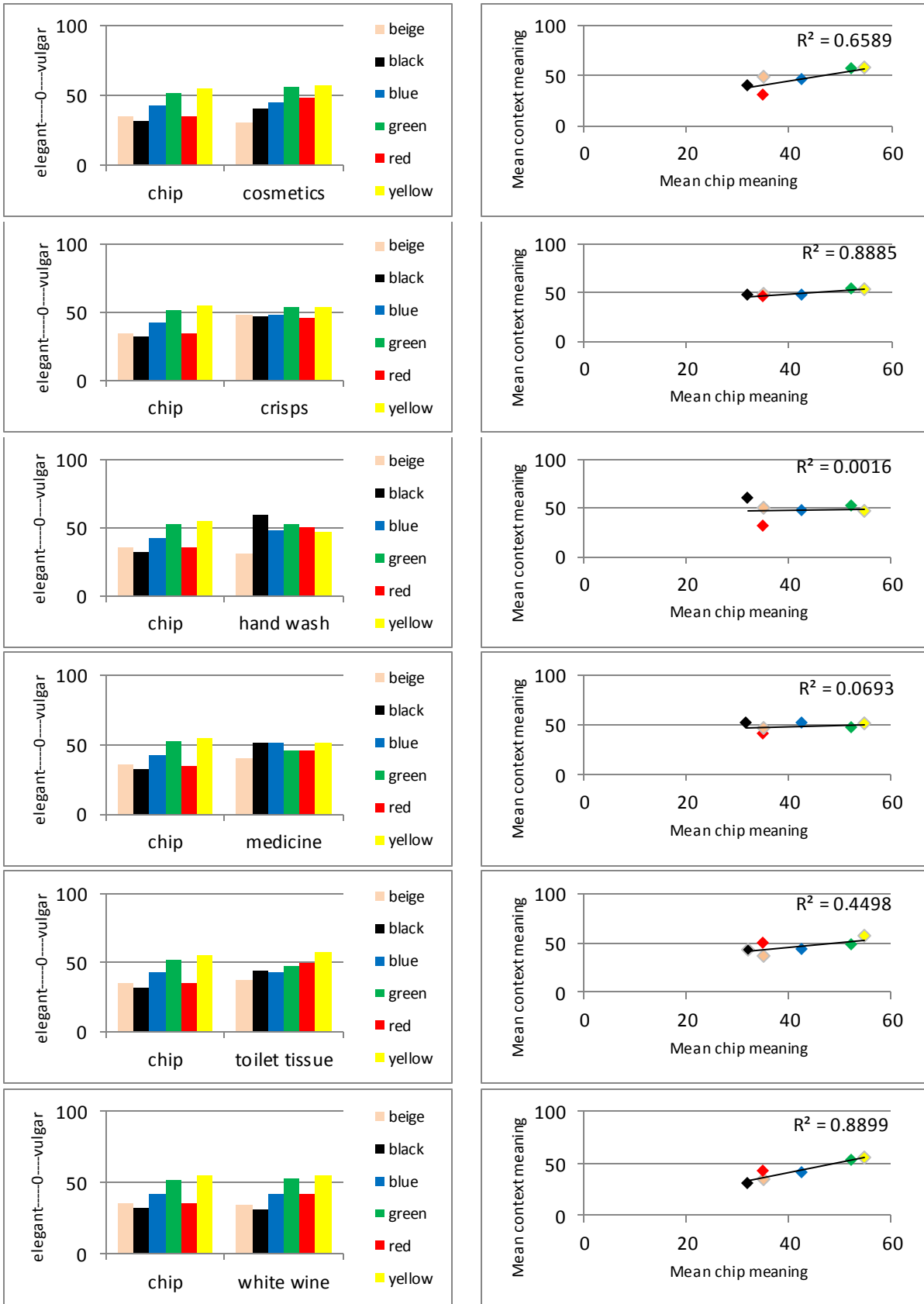
Figure 5.8 Mean and R-squared of chip and context meaning for elegant-vulgar

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Table 5.4 R-squared between chip and context meaning for five semantic scales

	cosmetics	crisps	hand wash	medicine	toilet tissue	white wine
Masculine - Feminine	0.99	0.94	0.96	0.30	0.93	0.96
Warm - Cold	0.99	0.98	0.98	0.94	0.96	0.99
Expensive - Inexpensive	0.71	0.83	0.01	0.37	0.77	0.80
Modern - Traditional	0.86	0.30	0.18	0.51	0.92	0.08
Elegant - Vulgar	0.66	0.89	0.00	0.07	0.45	0.89

r <0.2　　*r >0.8*

5.4.3 Paired-sample t-test (Part A)

The paired-sample t-test comparison was used in order to further explore for significant differences between chip meaning and context meaning. As shown in Table 5.5 there were 180 different comparisons between chip meaning and context meaning (6 colours × 6 objects × 5 bi-polar words) and each was subjected to a paired t-test. When the *p* values were higher than 0.05, they were marked with light grey colour, and when they were lower than 0.05, they were marked with dark grey colour. Statistical significance is therefore notated by a dark-grey colour. The result showed that 51 of 180 (28%) possible mean differences were significant. However, this cannot be said in every case for chip and context meaning. In 72% of cases, there is no significant difference between the chip meaning and context meaning. The greatest number of significant differences was found for red and black, for medicine and hand wash, and for masculine-feminine and elegant-vulgar.

Table 5.5 T-test between chip and context meaning for five semantic scales (part A). Bi-polar words abbreviations are: M-F = Masculine-Feminine, W-C = Warm-Cold, E-I = Expensive-Inexpensive, M-T = Modern-Traditional, E-V = Elegant-Vulgar

		M-F	W-C	E-I	M-T	E-V
BEIGE	Cosmetics	0.44	0.28	0.60	0.45	0.23
	Crisps	0.00	0.44	0.06	0.34	0.01
	Hand wash	0.21	0.15	0.23	0.30	0.45
	Medicine	0.03	0.02	0.16	0.42	0.18
	Toilet tissue	0.03	0.77	0.68	0.33	0.70
	White wine	0.01	0.00	0.52	0.07	0.83
BLACK	Cosmetics	0.00	0.53	0.06	0.87	0.03
	Crisps	0.15	0.31	0.76	0.04	0.00
	Hand wash	0.00	0.02	0.00	0.03	0.00

	Medicine	0.73	0.05	0.00	0.36	0.00
	Toilet tissue	0.04	0.31	0.12	0.35	0.00
	White wine	0.49	0.76	0.35	0.05	0.74
BLUE	Cosmetics	0.00	0.23	0.96	0.20	0.51
	Crisps	0.15	0.49	0.33	0.30	0.16
	Hand wash	0.28	0.83	0.04	0.30	0.19
	Medicine	0.02	0.23	0.06	0.41	0.02
	Toilet tissue	0.00	0.00	0.82	0.39	0.80
	White wine	0.06	0.38	0.11	0.07	0.80
GREEN	Cosmetics	0.01	0.52	0.48	0.39	0.32
	Crisps	0.89	0.81	0.09	0.81	0.74
	Hand wash	0.19	0.41	0.08	0.08	0.90
	Medicine	0.39	0.25	0.56	0.91	0.17
	Toilet tissue	0.04	0.15	0.65	0.35	0.29
	White wine	0.18	0.18	0.04	0.03	0.89
RED	Cosmetics	0.27	0.02	0.01	0.96	0.00
	Crisps	0.25	0.49	0.02	0.45	0.01
	Hand wash	0.23	0.04	0.03	0.71	0.01
	Medicine	0.00	0.00	0.01	0.03	0.00
	Toilet tissue	0.20	0.00	0.01	0.88	0.00
	White wine	0.16	0.00	0.37	0.81	0.05
YELLOW	Cosmetics	0.18	0.14	0.20	0.33	0.41
	Crisps	0.08	0.59	0.65	0.04	0.95
	Hand wash	0.85	0.25	0.02	0.07	0.08
	Medicine	0.10	0.00	0.24	0.12	0.39
	Toilet tissue	0.53	0.67	0.55	0.52	0.45
	White wine	0.41	0.03	0.94	0.56	0.88

p < 0.05   *p > 0.05*

5.4.4 Paired-sample t-test (Part B)

Recall that the object images used in part B were different from part A. Part B used 12 real packaging images (these were realistic images that were rich in context) whereas part A used simplified images where the context was less rich. Table 5.6 explores the difference between chip meaning and context meaning for part B; the results of t-tests are shown for the 30 possible comparisons. The results showed that for 13 of 30 (or 43%) of the comparisons the differences between the means were significant.

Table 5.6 T-test between chip and context meaning for five semantic scales (part B)

	M-F	W-C	E-I	M-T	E-V
Beige-Cosmetic	0.01	0.02	0.02	0.64	0.02
Black-Medicine	0.86	0.16	0.00	0.18	0.01
Blue-Hand wash	0.86	0.03	0.26	0.69	0.13
Green-Toilet tissue	0.01	0.00	0.17	0.99	0.43
Red-White wine	0.02	0.03	0.60	0.64	0.01
Yellow-Crisps	0.00	0.85	0.24	0.15	0.60

■ $p < 0.05$ □ $p > 0.05$

5.4.5 Paired-sample t-test (Part A and Part B)

Table 5.7 shows the results of the 30 possible t-tests that can be carried out between part A (chip) and part B (chip). In most case, there were no significant differences. However, in four of 30 (or 13%) of the cases the means between parts A and B were significantly different. In essence, this is testing whether the colours in parts A and B had different connotations (recall that the colours in the two parts were very similar but not exactly the same).

Table 5.7 T-test between part A (chip) and part B (chip)

Colour	(M-F	W-C	E-I	M-T	E-V
Beige	0.42	0.78	0.37	0.93	0.08
Balck	0.68	0.55	0.77	0.75	0.09
Blue	0.01	0.00	1.00	0.04	0.61
Green	0.13	0.01	0.10	0.41	0.73
Red	0.73	0.05	0.58	0.25	0.05
Yellow	0.82	0.97	0.20	0.17	0.07

■ $p < 0.05$ □ $p > 0.05$

Table 5.8 explores the difference in the mean ratings between part A (context) and part B (context). This seems reasonable to do given that Table 5.8 shows that broadly speaking the colours in the two parts can be thought of as being the same. The difference between part A and part B, however, is the richness of the context. In part A the context is simple whereas in part B the context is more complex and realistic. The results showed that there were no significant differences in the majority of cases with significance differences in just four out of 30 (or 13%) of cases.

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Table 5.8 T-test between part A (context) and part B (context)

Context	M-F	W-C	E-I	M-T	E-V
Cosmetic	0.19	0.01	0.70	0.98	0.92
Medicine	0.46	0.85	0.87	0.00	0.40
Hand wash	0.19	0.84	0.13	0.62	0.44
Toilet tissue	0.25	0.44	0.75	0.78	0.51
White wine	0.19	0.38	0.35	0.24	0.01
Crisps	0.14	0.62	0.01	0.41	0.29

■ *p < 0.05* □ *p > 0.05*

5.5 Discussion

This section discusses key findings for the colour meaning experiment conducted in this chapter. After that, the limitations of the methods adopted for the study are discussed.

5.5.1 Reflection on the results of research question 4.1

The colour meaning experiment in this chapter was focused on the question of whether colour meanings are affected by context – RQ4.1 of this thesis. The research question arose from analysis of interviews and the online surveys in Chapter 4. Chapter 4 reported that 'colour meaning' is one aspect of colour information that is useful in packaging and branding and that 'colour meaning in different product categories' was one of the suggestions (from the interviewees) for a colour tool.

Prior research on colour meaning tends towards two different perspectives. The first is that colours have consistent meanings no matter the context in which the colour is applied. The second is that colour meanings change when the context in which the colour is applied changes. However, colour meaning research in packaging and branding is rare, and theoretical colour knowledge arises from the prior studies where colours are simplified into colour chips. Moreover, the simplified colour chips are commonly used in many design resources. Hence, it was recognised that it is necessary to explore the relationship between colour and context within packaging and branding. The present research was conducted with 25 participants. In the part A of the experiment, a total of 42 images (six colour chips and six objects corresponding to the six colours) were evaluated against five bi-polar words (masculine-feminine, warm-cold, expensive-

inexpensive, modern-traditional and elegant-vulgar). The object images were revised removing graphics of each packaging. In the part B of the experiment, a total 12 images (six colour chips and six objects) were evaluated in the same manner as the part A. However, the images used in the part B were real package images which had richer and more complex context that the images used in the part A. The descriptive summary and conclusions of the results from parts A and B are as follows:

In part A, in about two thirds of cases, there was no significant difference between chip meaning and context meaning with significant differences in just 28% of cases. Notable differences were found for black and red colours, for hand wash and medicine, and for masculine-feminine and elegant-vulgar (though not in every case of course).

In part B, slightly different colours were used for the chip colour by necessity. This makes the comparison between a simplified context (part A) and a rich, realistic context (part B) more difficult. However, it was shown that the differences between the colours used in part A and part B were small. Given this, it was possible to compare the difference between chip and context meaning in the two cases (part A and part B). It was found that the per cent of cases where there was a significant difference between chip and context meaning rose from 28% (simple context) to 43% (rich context). This part B shows a greater effect of context (which is not surprising) but nevertheless more than halve of all cases showed no significant effect of context even in part B. Note also that part B used a relatively small number of images (12) compared with part A (42).

Research question 4.1 of the thesis was whether colour meanings are affected by context. The answer from this is not a categorical yes or no; rather the answer is that context sometimes affects colour meaning but sometimes does not. Nevertheless, in neither part A nor part B did the context affect the meaning is more than 50% of cases. The lack of a context effect is perhaps surprising in many cases. However, note that this work only used a small number of colours and a small number of bi-polar terms. This and other limitations in the work are discussed in the next section. The work does, however, support the notion that there is value in exploring chip colour meanings but that context-based colour meanings may need to be measured if greater reliability is

needed. The work does suggest that the simplified contexts used in part A may be useful and a convenient compromises between context-less studies and full-context studies.

5.5.2 Critique of the research methods

Although semantic differential (SD) is commonly used in attitude measurement study, the SD has certain limitations. One weakness of research methodology rather than SD scale itself is that researchers tend to select bi-polar words without providing any empirical rationale for their choice (Jayne, 1996). This could lead meaningless data and as a result not supported evidence of research validity. Thus, this chapter extracted words reviewing relevant colour meaning literature and relating the object characteristics used in the colour meaning experiment conducted in this chapter.

Another problem that may not be prevented by the use of SD is whether the result is reliable over time. A sample of 25 participants is small to draw any generic conclusions. However, this chapter did not intend to generalise the results but to utilise the insight to a colour case study (Chapter 7) and a prototype development of a colour tool which will be detailed in Chapter 8.

5.6 Conclusions

5.6.1 Key insights

This colour meaning experiment makes a contribution to the understanding of the contextual dependence and independence of colour meaning. The results show that beige, blue, green and yellow are applicable without consideration of context. However, red and black is less applicable especially in hand wash and medicine. In other words, some colours are influenced by the context and some colours not. The key findings of this chapter have three implications.

In design practice perspective, colour meaning information derived from past studies where colours are simplified into colour chips can be used to some extent, however,

designers and brand managers may want to consider context meaning for more sophisticated design strategy. Especially, it should be careful to use colours of red and black, specifically in hand wash and medicine since these colours and are highly affected by context.

In methodological perspective, in the further investigation of the colour meaning within brand packaging, it is suggested to use colour stimuli as a priority of object images used in the part A (13% differences between context meaning and real packaging context meaning, which was corrected in Photoshop), colour chips (28% differences between chip meaning and context meaning) and real packaging (43% differences between chip meaning and context meaning).

In a colour tool development, the insight of this chapter recognised that a colour-meaning-centred tool, which provides accurate colour information according to the different categories, may be useful for designers and brand managers to use colour more strategically, enhance insight and strong back up for their colour decision. Also, colour chips should be organised by different product categories since some colour meanings are affected by context.

5.6.2 Next step

In the next chapter, a colour meaning framework is established in order to provide an understanding of what colour meanings are communicated in a product category: RQ4.2.

Chapter 6
COLOUR MEANING FRAMEWORK

> *"Colour function as a sign for a physical phenomenon, for a physiological mechanism,*
> *or for a psychological association" (Caivano, 1998, p.390)*

This chapter builds a colour meaning framework that integrates existing colour strategies and semiotic theories.

6.1 Development of colour framework

Semiotic theories have been studied in different areas, such as language and philosophy, to explain what a sign is. Colour is a sign that conveys certain physical or psychological properties, yet surprisingly few attempts have been made to use the semiotic concept to describe colour meanings (Caivano, 1998). Moreover, although colour is a significant communicator in design (Aslam, 2006), formal studies about the colour meanings conveyed in a product category are rare. In order to address this question, this section develops a colour meaning framework through the integration of existing colour strategies and the concept of colour semiotics. Figure 6.1 presents the development process of a colour meaning framework. Firstly, the manner in which colour is used in packaging and branding is explored by reviewing existing colour strategies (Section 6.2). Secondly, from a semiotic perspective, through the use and application of colour, the meanings that are communicated are also investigated (Section 6.3). Lastly, a colour meaning framework is presented that potentially can be used as a colour analysis tool in design process and strategy (Section 6.4).

```
1  Colour strategies:          2  Colour semiotics:            3  Colour meaning framework:
   Studies of existing            Analysis of existing design     4 categories of colour
   colour strategies              cases in a semiotic perspective  in a product category
```
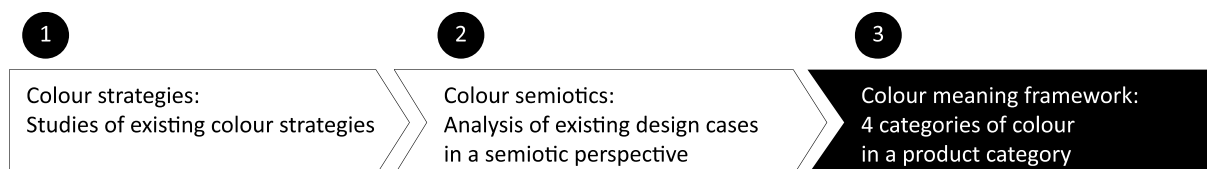
Figure 6.1 Process of developing the colour meaning framework

6.2 Existing colour strategies

In general, following a dominant colour in a product category or introducing a new colour is a commonly used colour strategy to achieve competitive advantages (Lightfoot and Gerstman, 1998; Kauppinen-Räisänen, 2014). Caivano and Lopez (2007) introduced four colour strategies, including the two aforementioned strategies. They were concerned with following a generic colour code, acting against it (transgression), localising it, and developing marketing-related adaptations. These four strategies are briefly discussed in the following sections.

6.2.1 Generic colour code

A generic colour code strategy refers to using colours that are commonly employed by different products within the same product category, such as hand wash, toilet tissue, etc. (Caivano & Lopez, 2007). For example, in the category of milk cartons, red is used for skimmed milk; green is for semi-skimmed milk; and blue is for whole milk (at least, in the UK this is the case; however, such generic colour codes sometimes vary between different geographical locations). In the washing-up liquid category, a yellow colour is used for a lemon flavour; light green is for apple; red is for cherry; and orange is for orange, as shown in Figure 6.2. This strategy is generally recommended since people tend to remember representative colours for familiar objects (Siple & Springer, 1983) and our brains use the retained association as shortcuts (Ball, 2008; Piqueras-Fiszmana *et al.*, 2012).

Figure 6.2 Generic colour use of milk (left) and washing-up liquid (right) packaging

The use of a dominant colour in a product category sometimes contributes to the success of one particular brand (Lightfoot & Gerstman, 1998) and also often prompts other brands to follow the packaging colour of the market-leading product. One of the

most frequently cited examples is Coca-Cola. The use of red allows consumers to immediately associate the type of beverage; some brands, such as Sainsbury's cola, and Virgin cola, have taken advantage of this recognition with similar red cans, as shown in Figure 6.3. Due to the strong relationship between Coca-Cola and the colour red, Pepsi changed its brand colours from red to blue to differentiate it from Coca-Cola.

Figure 6.3 Red established by Coca-Cola

Moreover, this modality of using a generic colour code is observed in bank logos. Green and blue colours are frequently used in order to shape brand images, such as stable and truthful (Grimes & Doole, 1998). Figure 6.4 shows the colours green and blue as used in famous banks' logos.

Figure 6.4 Generic colour use of bank logos

However, sometimes generic colour codes established for one product category can negatively affect another (related) category. In 2006, Nestlé Smarties, which is a popular sugar-coated chocolate brand, changed its previous blue coating to a white one because of consumers' concern over the effect of chemical dyes on children's health. However, white is an established generic colour code for the related category of medicinal tablets, as shown in Figure 6.5. More than 20 Facebook groups (that included almost 2,000 members) requested a return to the blue sweets (Smithers, 2008). White Smarties were later replaced by blue Smarties in the UK in 2008 which were created using a natural blue dye derived from seaweed.

Figure 6.5 Nestlé Smarties blue (left) and white (right)

Another example of the use of a generic colour code performing poorly in the marketplace is Coca-Cola's redesigned white can. In 2011, Coca-Cola launched white cans with silver polar bears to replace their trademark red cans (see Figure 6.6). This was a temporary change to support the World Wildlife Fund in protecting the polar bear. The white cans were unique and visually appealing. However, the colour change confused consumers due to their similar colour to Diet Coke. One month after the launch, the Coca-Cola returned to their trademark red containers (Environmental Leader, 2011). This is an example of Coca-Cola breaking an established generic colour code (red for normal coke and white for diet coke) which has an unsuccessful outcome.

Figure 6.6 Red design established by Coca-Cola (left)

and the redesign using a white can (right)

6.2.2 Colour differentiation

A colour differentiation strategy involves the use of different colours than those commonly employed in existing product categories. Armstrong and Kotler (2015) described differentiation as creating a unique value for the intended audience. Product differentiation is a typical marketing strategy, and General Motor's colour strategy is a well-known example of a company that differentiates itself from its competitors using colours (Gregory *et al.*, 1994). General Motors introduced colourful products to an existing market that generally only used black.

A second example where breaking with generic codes can be successful can be found in

high-value products such as cosmetics. In this product category, breaking an established generic colour code and using a unique colour to represent the brand (to stand out from competitors) can be a successful strategy. Figure 6.7 shows the Clarins' red brand colour in contrast with the Chanel cosmetic brand which uses the more generic black.

Figure 6.7 Cosmetic brand colours for Clarins (left) and Chanel (right)

Heinz's green ketchup packaging is another example of the success of using unexpected colours in ketchup categories. Heinz launched green-coloured tomato ketchup packaging for children in 2000 (Figure 6.8). The use of this unusual colour illustrates how customers perceive colours for the packaging of food products. There were many concerns that children would not like the green colour as they would associate it with vegetables, and green ketchup could also be rejected by adults because green is an inappropriate colour choice for the sauce (BBC News, 2000). However, the customers' response to green ketchup was different than expected since such a colour went against the semiotic notion that ketchup is supposed to be red, although this idea had not been shaped in kids' minds yet. Heinz announced a 51% increase in its market share and a 5% increase in profits due to the success of its green ketchup sales (Hays, 2000).

Figure 6.8 Generic colour (left) and novel colour (right) in the ketchup category

However, despite the phenomenal success of green ketchup, over time sales dwindled and the product was removed. The generic colour code of red for ketchup is extremely

powerful and the green colour was successful in the short-term (with its shock/surprise effect and the connotation with fun); however, once the novelty of the surprise wore off the power of the established generic colour code won.

Another successful example of colour differentiation is McDonald's use of green in Germany. Red and yellow are generic colour codes in the fast-food industry and are also used by one of the market leaders McDonald's (see Figure 6.9). McDonald's Germany changed their logo colour in 2009 from the original yellow and red to yellow and green. The aim for this radical colour makeover was to build up a more eco-friendly image in Europe. A new colour scheme for a brand signifies a bold move in business philosophy, target audience, and strategy, as it is often necessary to change every colour scheme for a restaurant or the packaging that is associated with a brand's appearance. The colour change of German McDonald's brought significant growth with the opening of 42 new restaurants that year (NBC News, 2009).

Figure 6.9 Generic colours and McDonald's transgression colour (far right)

in the fast food category

However, sometimes having a colour that is different than the norm causes confusion (Piqueras-Fiszmana & Spence, 2011). For example, Golden Wonder first launched cheese and onion flavoured potato crisps in green packaging and salt and vinegar crisps in blue packaging in the 1960s. Generally in the UK, crisps in a blue packet have become strongly associated with salt and vinegar flavour, while a green packet suggests cheese and onion flavouring. However, Walkers, which is one of the biggest crisp brands in the UK, decided to change the generic colour codes into a green packet for salt and vinegar and a blue packet for cheese and onion in the 1980s (note that there is some controversy over whether Walkers did change colours of whether they have always been different to the other brands). Recently, Golden Wonder claimed that the use of different colours between the brands confuses consumers and requested all manufacturers use

the same coloured packaging for both crisp flavours (Mcdermott, 2013).

Figure 6.10 Generic colours and Walkers' transgression colour (far right)

in the crisp category of cheese and onion flavours

6.2.3 Cultural adaptation

Culture-related colour strategy is associated with colour changes when brand or corporate colours are exposed to different cultures or countries (Caivano & Lopez, 2007). This happens because colour can convey different meanings in various cultural contexts (Singh, 2006). For instance, red symbolises masculinity, fear, and anger in western culture while it indicates love and happiness in Asian culture (Aslam, 2006). This contrast of ideas sometimes leads to colour change in order to convey appropriate messages to consumers in different cultures.

A relevant example of inappropriate colour use was an instance at United Airlines in 2010 (Wooten, 2011). The airline started a new first-class service that involved giving white carnations to passengers. Unfortunately, white flowers represent death and misfortune in China. The airline quickly switched to red carnations, which convey more positive meanings in many cultures.

An example of colour change in different cultures is the logo of Petrobras (Caivano & Lopez, 2007). The logo colours of the Brazilian company Petrobras include green and yellow in a clear representation of the Brazilian flag's colours. When the company was introduced in Argentina, they changed the corporate colours from yellow and green to yellow and blue in order to downplay their Brazilian image and integrate a familiar image into a new cultural context involving blue, which appears in the flags of both Brazil and Argentina, as shown in Figure 6.11.

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Figure 6.11 The Brazilian oil company Petrobras (left)

and Petrobras in Argentina (right)

6.2.4 Marketing-related appropriation

Marketing-related colour strategy is associated with giving up a corporate colour and replacing it with other colours to generate positive meanings when an organisation is exposed to different commercial, national, and political environment. The use of a consistent corporate (or brand) visual identity has been stressed in order to deliver a uniform message (Bosch *et al.*, 2005). Although changing a representative brand colour is a big move used to initiate marketing-related objectives, companies sometimes have to relinquish their colours. Traditionally, football teams adopt particular colours to distinguish themselves from others. The colour choice is generally based on the popularity of the colour, and football fans tend to link certain qualities to colours and the nature of a football team (Koo, 2009). For instance, as the colour black is generally perceived as powerful (Aslam, 2006), football fans may think that the team members with black uniforms are also bold and powerful. Chelsea's football uniform colours for the 2011-2012 season are one example of how their sponsor's corporate colour had to change in the context of soccer. In the case of Chelsea's uniform colour, Samsung adopted yellow and black for the team uniform along with their trademark colour blue due to the influence of the yellow logo colour worn by Chelsea. Thus, it is significant to find a confluence between the football team's original colour and the sponsor's corporate colour.

Figure 6.12 Chelsea FC's shirt for the 2011-2012 season (Football Kit News, 2011)

6.3 Colour semiotics

Colour is a type of physical (or visual) stimuli, and in a semiotic sense, it functions as a sign (Caivano, 1998). A sign approximates something else and has meaning for people (Caivano, 1998). Semiotics is the study of signs, and two primary traditions in contemporary semiotics are associated with the Swiss linguist Ferdinand de Saussure (1857-1913) and the American philosopher Charles Sanders Peirce (1839-1914). Saussure illustrated semiology as a science that investigates the role of signs, which influences the formation of social meanings. Pierce, on the other hand, used the term 'semiotic', which refers to a 'formal doctrine of signs' (Chandler, 2002, p.3). Although Peirce and Saussure were both concerned with the fundamental definition of the sign, in recent times, the term *semiotics* has widely been used as an umbrella term to accommodate the whole field. Saussure's theories were a starting point for analysing signs. He defined a sign as being composed of a signifier (form) and the signified (its meaning). The signifier is the form which a sign takes, while the signified is the meaning conveyed by a sign. Figure 6.13 shows a linguistic example provided by Chandler (2002); the term 'open' is a sign consisting of the following:

- A signifier (form): the word 'open'
- A signified concept (meaning): that the shop is open for business
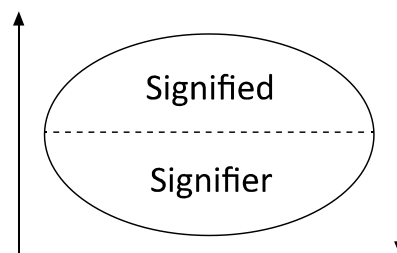
Figure 6.13 Saussure's model of the sign (Chandler, 2002, p.15)

When applying Saussure's model to colour as a visual sign, a specific colour (e.g. black) is a signifier, and colour meaning is the signified concept, such as seriousness or modernity for the black, as shown in Figure 6.14. Thus, the colour meaning includes the connotations that are related to certain colours.
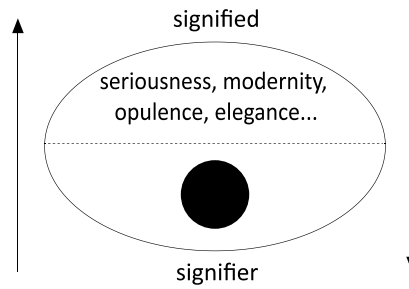
Figure 6.14 Various meanings of black in different contexts

More specifically, Peirce offered three taxonomies of signs to explain what is presented by a sign, while Saussure did not suggest a typology of signs. Peirce's three elements are icon, index, and symbol (Chandler, 2002), as shown in Figure 6.15. An iconic sign is related to the resemblance between a sign and an object. An indexical sign is linked with a signal, clue, or a symptom that denotes a physical connection between a sign and an object. For instance, a grey sky is a signal that rain may follow. A symbolic sign refers to arbitrariness and conventionality between a sign and an object.
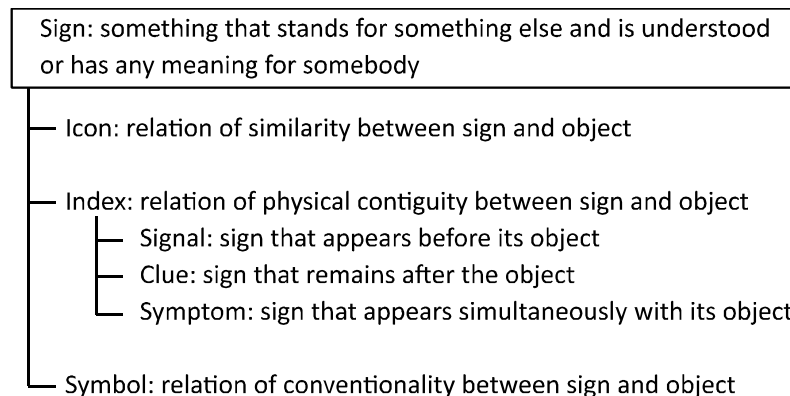
Figure 6.15 Three types of signs provided by Peirce (Caivano, 1998, p.391)

Caivano (1998) applied Peirce's semiotic theory to colour and introduced three levels of colour meanings that colours can represent. Figure 6.16 presents an example of iconic, indexical, and symbolic associations for the colour green. Colour as an iconic sign is related to the similarity to the original substance colour. Thus, the colour green is an iconic representation of green grass. Colour as an indexical sign is related to the congruity between colour and object. A green colour is an index of naturalness, and the

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representation of colour is related to the original substance colour or may even be arbitrary. Colour as a symbolic sign is linked to arbitrariness in its meaning. The symbolic associations of the colour green are related to arbitrary meanings, such as security or reliability (Grimes & Doole, 1998), which have no relations physically with the colour but instead are articulated socially or culturally.
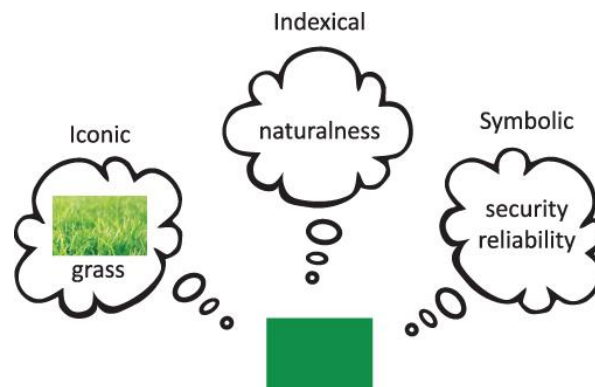
Figure 6.16 An example of colour associations for the colour green

6.4 Colour meaning framework

As reviewed previously, there are four types of colour strategies: a generic colour code, a differentiated colour, the adaptation of colours in different cultures, and marketing-related colour use. Using a generic colour code is related to employing a predominant colour that is commonly used in a product category (e.g. blue for whole milk). Differentiated colours are adopted to make a product/packaging stand out within a product category. Heinz's green ketchup and a brand's trademark colours are good examples of the use of differentiated colours that can draw consumer attention in a competitive market environment. The other two colour strategies, which are adapting colours in different cultures and marketing-related colour use, are associated with colour change or relinquishing brand colours when brand or corporate colours are exposed to different cultures, countries, or markets. However, from a broad standpoint, culture and marketing-related colour strategies can be a part of a generic colour code strategy or a colour differentiation strategy that generates familiar or differentiated images through the use of colour in different cultural or commercial environments.

When applying the notion of colour semiotics to practice (colour strategies), it should be recognised that some colour meanings are perceived in relation to the product's category. Figure 6.17 presents an example of how iconic, indexical, and symbolic colour representations work in packaging colours. It is apparent that a yellow colour for a washing-up liquid product is derived from lemon (original substance) to represent lemon flavour—iconic colour. A yellow colour also may offer a clue that allows consumers to guess how fresh the lemon is—indexical colour. In other words, consumers might associate more freshness when the extent of the yellow colour is associated with the original lemon colour. Thus, the indexical colour is related to either the original substance colour or an arbitrary colour. Moreover, in terms of the milk packaging colour, there is no similarity or connection between the colours and milk, and arbitrary colours are used (e.g. red for skimmed, green for semi-skimmed, and blue for whole milk). Considering these factors, in a design context, the three types of colour semiotics can be summarised into two characteristics: whether the colour associations are derived from the original substance colour or are arbitrary. In other words, iconic colour is related to original substance colour, and indexical colour can be derived from original substance colour or may be arbitrary. Symbolic colour is related to arbitrary colour.
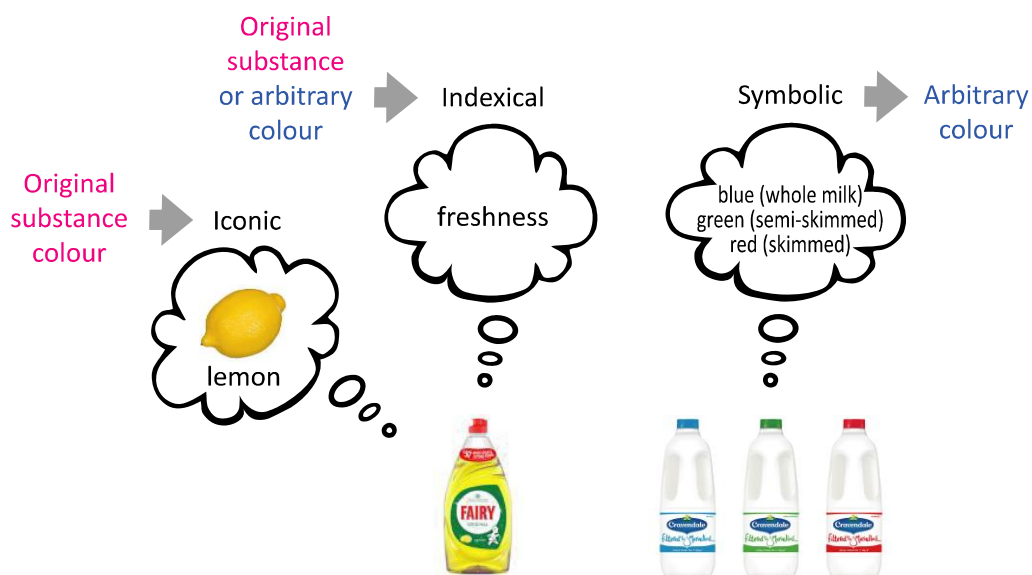
Figure 6.17 Colour in semiotic theory

To sum up, four categories of colour in a product category are communicated. They are *original substance colour (iconic or indexical colour), arbitrary colour (symbolic or indexical colour), generic colour,* and *differentiated colour.* By linking the aforementioned colour practice with the semiotic theories, Figure 6.18 shows the transitory process of the colour meaning framework development to help the reader understand how it has been developed. Figure 6.19 proposes the final illustrative version of the colour meaning framework.

Colour meaning framework

Product

Signifier

Colour strategies (section 6.2)

Generic colour

using colours that are commonly used in different product categories

Differentiation

using different colours to those commonly used in existing product categories

Culture & Marketing related

colour change when brand or corporate colour exposed to different culture or countries

Colour in semiotics (section 6.3)

Iconic colour

Original substance colour

Indexical colour

Clue to guess the characteristics of the substance by colour

Symbolic colour

Arbitrary colour

Consumer

Signified related to:

4 categories of colour in a product category
• Original substance colour
 (Iconic or indexical colour)

• Arbitrary colour
 (Symbolic or indexical colour)

• Generic colour

• Differentiated colour

Figure 6.18 Transitory process of colour meaning framework development integrating practice and semiotic theory
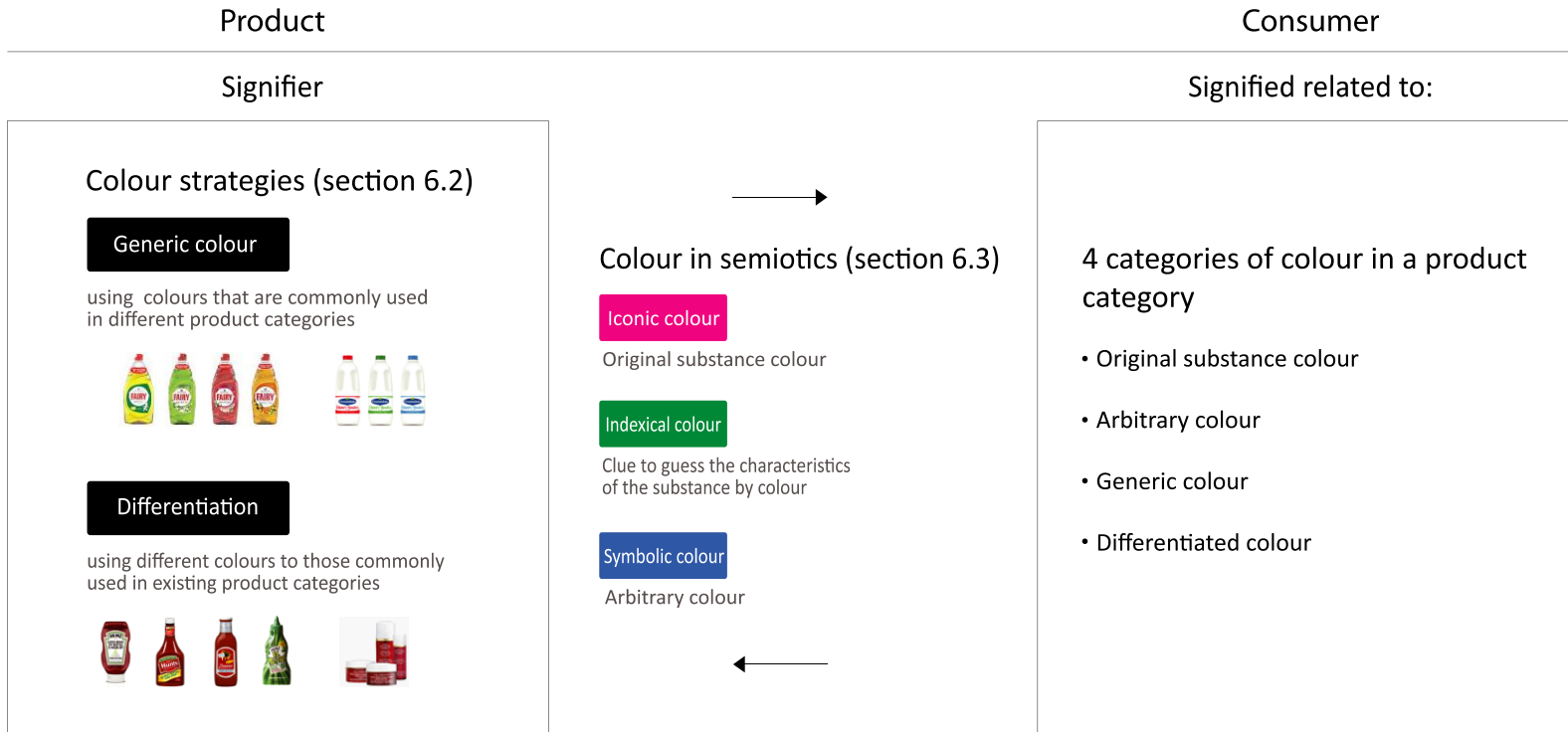
Figure 6.19 The final illustrative version of the colour meaning framework

6.5 Conclusions

In this chapter, a colour meaning framework was established by integrating the existing colour strategies and semiotic theories. The framework is a synthesis of the study supported and tested against both secondary and primary research, and can be applied in practice by designers, marketers and brand managers. Moreover, based on the illustrative version of the colour meaning framework, a succinct version of a colour meaning framework in Figure 6.20 is proposed. This concise framework can be employed in various colour, design, semiotics or marketing related research as a research tool to investigate and analyse colour.

Product		Consumer
Signifier		Signified related to:

| Colour | Iconic → Indexical Symbolic ← | • Original substance colour

• Arbitrary colour

• Generic colour

• Differentiated colour |
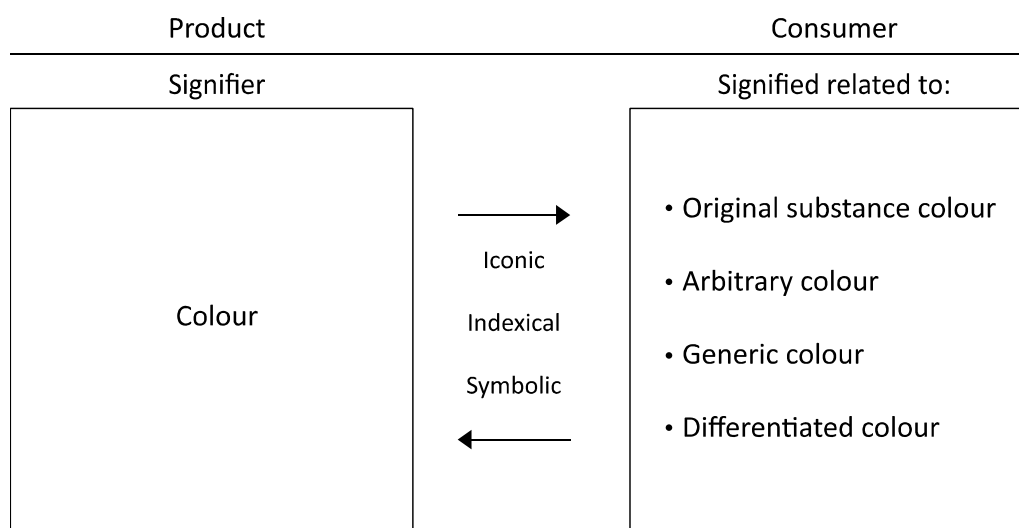
Figure 6.20 The succinct version of the colour meaning framework

To illustrate how the framework can be used to classify and describe colour meanings within a product category, Figure 6.21 shows how a two-dimensional feature space can be constructed from the four colour-meaning categories for crisps. Twenty products (representing five brands) were collected and analysed. The main characteristic of the crisps packaging colours is that there is a generic colour code cross various brands: red for original version, blue for salt and vinegar flavour, light green for sour cream, green for cheese and onion, yellow for cheese, pink for sweet chilli and brown for chicken. The colour uses of red for original, blue for salt and vinegar, and light green for sour cream are arbitrary since there are no relations between colours and products whereas yellow,

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pink, green and brown colours are derived from original substance colours of cheese, chilli, spring onion and chicken. In terms of differentiated colour use, as mentioned previously, Walkers sells a blue packaging product for cheese and onion flavour to stand out from competitors while other brand sells green packaging for the same flavour.

Figure 6.21 Colour analysis for the current crisps products available in the UK

In the next chapter, a colour meaning case study is conducted to gain depth insight of colour meaning in a product category: RQ4.2. The developed colour meaning framework will be used as a colour analysis tool for washing-up liquid packaging colours.

Chapter 7
COLOUR MEANING CASE STUDY

"Consumers expect to see a particular use of colour"

(Lightfoot and Gerstman, 1998, p.49)

This chapter conducts a colour meaning case study focusing on washing-up liquid packaging. The purpose of the chapter is to explore the potential that colour meaning information can assist design professionals with real-world packaging design problems where colour is a major consideration.

7.1 Introduction

A case study refers to "the detailed examination of a single example of a class of phenomena" (Penguin Dictionary of Sociology, 2000, p.41). Moreover, case studies have been used for various purposes (Yin, 1994), and can include various methods to collect data (Blaikie, 2000). This chapter carried out a colour meaning case study in order to obtain deep insight on colour meaning in a product category. One particular product category—a washing-up liquid product—was selected based on the suggestion from the brand manager in a leading UK consumer goods manufacturing company that colour is a major design factor. In the first phase of the study, market research, interviews and an online survey were carried out with consumers (to explore what elements are important when they purchase a washing-up liquid product). Next, a colour meaning experiment was conducted to explore possible colours for washing-up liquid packaging. Lastly, an interview with a brand manager in a company was undertaken to collect their opinions for the developed packaging colours during this case study and the usefulness of this kind of colour meaning information in their packaging development process.

This chapter consists of six sections. Section 7.1 summarises why and how the colour meaning case study was carried out in this chapter. Section 7.2 presents the aim and objectives of this chapter. Section 7.3 presents market research for the current UK washing-up liquid products. Section 7.4 illustrates the process of colour development

for washing-up liquid packaging. Section 7.5 discusses the key findings and study limitations of this chapter. Section 7.6 outlines conclusions and the next steps.

7.2 Aim and objectives

The aim of the chapter was to gain deeper insight on colour meaning in a product category. The following objectives were devised to achieve the aim.

1. To explore current washing-up liquid products available in the UK.
2. To investigate possible colours for washing-up liquid packaging.
3. To collect a brand manager's opinions for the developed packaging colours and the usefulness of colour meaning information in their packaging design process.

7.3 Current UK washing-up liquid products

In order to build an understanding of current UK washing-up liquid products, brief market research was conducted based on four basic marketing components – product, price, place (distribution), and promotion, which are known as the four Ps (Armstrong and Kotler, 2015).

Products

Washing-up liquid products in the UK market can be divided into proprietary brand and own-label brand (Calver, 2004). A proprietary brand is defined as a brand of product that is privately developed and belonged (Collins English Dictionary, 2013). Brands such as Fairy, Persil, Morning Fresh, Ecover and Surface are proprietary brands that are commonly found on the shelves in large UK supermarkets. An own-label brand refers to brands that are controlled by a major supermarket retailer such as Sainsbury's or Tesco. Figure 7.1 presents a colour analysis for the UK washing-up liquid packaging using the colour meaning framework established in Chapter 6. Forty-four products of 10 brands (six proprietary brands and four own-label brands) were collected and analysed. A list of the UK washing-up liquid products is provided in Appendix D1. The main characteristic of the packaging colours is that there is a generic colour code cross

various brands: deep green for original, yellow for lemon, orange for orange and light green for apple. The colour use of deep green colour for original washing-up liquid product is arbitrary since there are no relations between colour and product whereas yellow, orange and light green colours are derived from original substance colours of lemon, orange and apple. In terms of differentiated colour use, Fairy also sells a silver packaging product for platinum and blue for eucalyptus flavour; Ecover sells a blue packaging product for camomile flavour and yellow for mango; Morning Fresh has light green packaging product for sensitive skin; and Waitrose has yellow packaging product for citrus flavour, red for apple and blue for sea grass. In addition, the majority of the packaging materials are transparent. Thus, packaging colour and colour of liquid are regarded as the same in this chapter.

Prices

Price means the amount of money when consumers purchase the product. The majority of washing-up liquid products range from £1 to £2 both in large supermarkets and online. However, in two cases, Ecover and Method, the prices are slightly higher than others, in the range £2.5 to £3.

Place (distribution)

Place refers to channels or locations that make the product available to target audiences. Large supermarkets and online shopping are typical distribution channels for washing-up liquid products.

Promotions

Promotion includes activities that make consumers aware of a product or a brand. Various types of advertisements through posters, television or radio commercials are typically executed by washing-up liquid manufacturing companies.
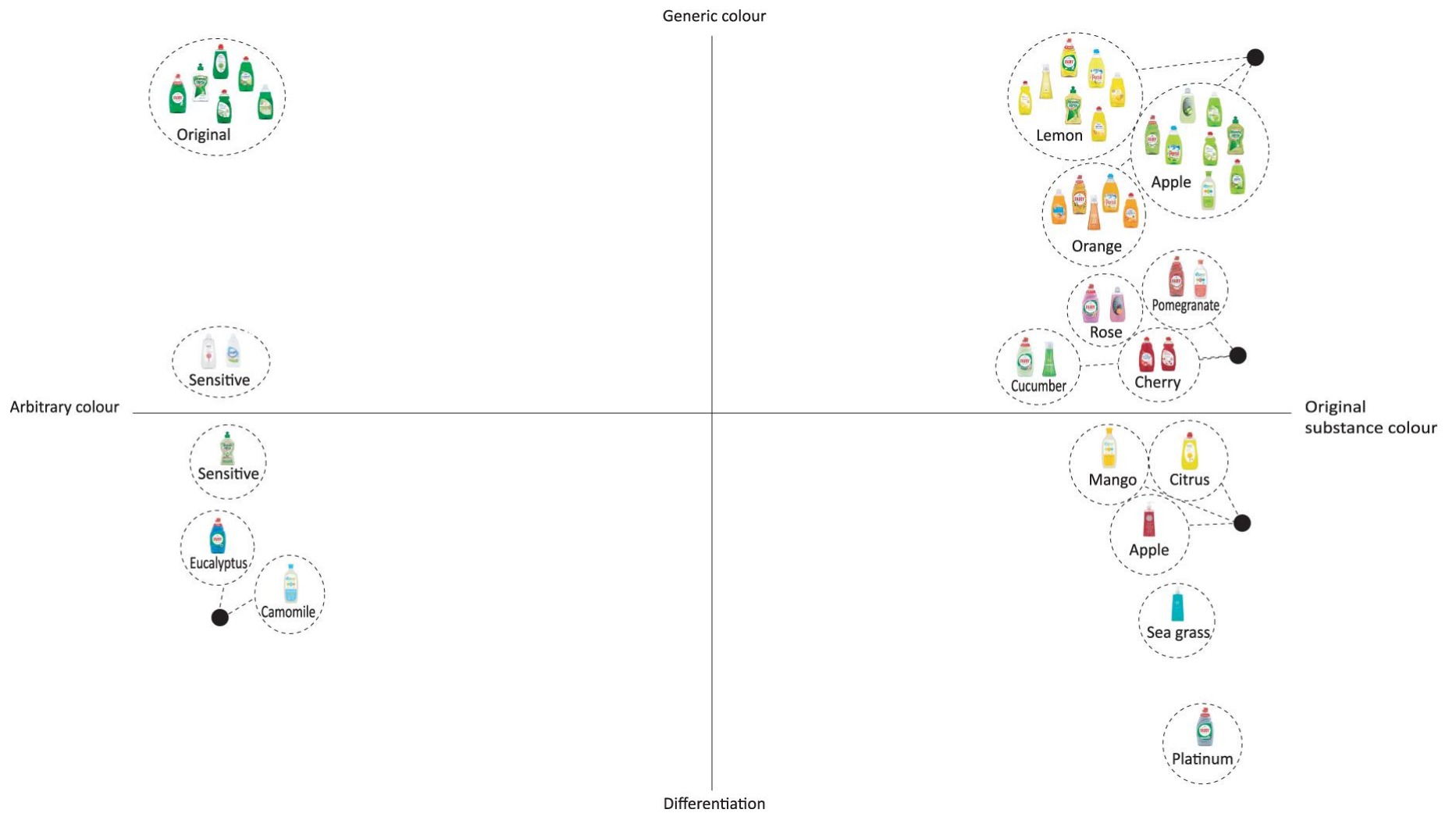
Figure 7.1 Colour analysis for the current washing-up liquid products available in the UK

7.4 Development of colours for washing-up liquid packaging

Figure 7.2 presents the colour development process for washing-up liquid packaging. The process includes 1) - 2) semi-structured interviews and an online survey with consumers to identify what elements are important when they buy a washing-up liquid product; 3) a colour meaning experiment with consumers to explore which green colours represent expensive-inexpensive, effective-ineffective, safe-unsafe and environmentally friendly-non environmentally friendly; and lastly 4) a semi-structured interview with a brand manager in a leading UK consumer goods manufacturing company to collect opinions for the developed packaging colours, and the usefulness of this kind of colour meaning information for their packaging development process.
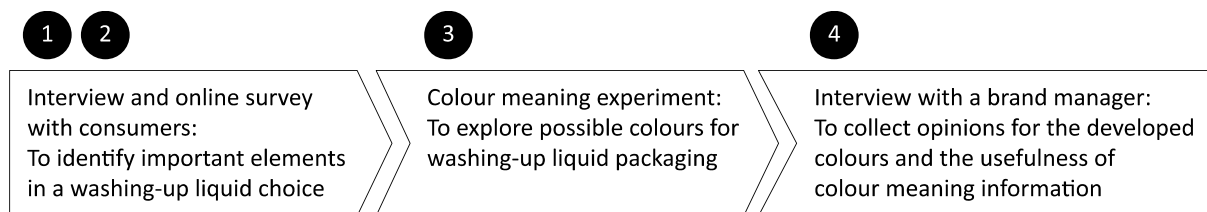
Figure 7.2 Process of developing possible colours for washing-up liquid packaging

7.4.1 Data collection methods

Table 7.1 presents data collection methods used for this colour meaning case study.

Table 7.1 Data collection methods

Data collection	
Semi-structured interviews	Face-to-face Interviews (N=10) and an online survey (N=74) with consumers were conducted.
Online survey	
Colour meaning experiment	25 participants (students at Leeds University) rated a total of 19 images against the four bi-polar words (expensive-inexpensive, effective-ineffective, safe-unsafe and environmentally friendly-non environmentally friendly).
Semi-structured interview with a brand manager	One brand manager in a leading UK consumer goods manufacturing company was interviewed in person.

7.4.2 Interview with consumers

In order to identify which elements are important when participants buy washing-up liquid, semi-structured interviews with 10 participants were undertaken. The following sections describe the process of recruiting participants, and the data collection process and data analysis.

7.4.3.1 Interview process

Recruitment of participants

In total, 10 participants (students and school staffs at Leeds University, married (N=5) and single (N=5)) between the ages of 25 and 45 were recruited. Participants were screened by asking whether they had bought a washing-up liquid product during the last 12 months.

Data collection process

All participants received an information sheet and interview questions (Appendix D2) before the interviews were carried out. The information sheet outlined the use of the data and the participants' rights to withdraw from this study. The questions included issues such as: whether participants buy a washing-up liquid product, how often to purchase, where to shop and what elements are important. Before beginning the interviews, participants received an informed consent form (Appendix D 3). The interview time was generally within 15 minutes.

Data analysis method

In order to code and organise the data, a template approach (King, 2012) was used. All interviews were audio-recorded and transcribed verbatim. Then, the data were coded using NVivo 10 and displayed in tables.

7.4.3.2 Results

Table 7.2 presents a summary of how often, where to shop and what elements are important when participants buy a washing-up liquid product. The maximum frequency was 10 (because the total number of participants was 10). No matter how many times

the specific response was mentioned by one interviewee throughout the interview, it was counted as being mentioned once. The responses most frequently mentioned are presented at the top of the list.

Table 7.2 Emerged themes from interviews with consumers

Purchase frequency	Frequency of mentions
Every two months	6
Every month	2
Every two weeks	1
Twice a year	1
Purchase place	
Large supermarkets	10
Internet delivery	1
Small shops	1
Determinants of product choice	
Price	5
Smell	4
Efficacy	4
Colour (of packaging or liquid)	4
Safety	2
Brand	2
Size of packaging	1
Shape of packaging	1

The result shows that the majority of participants buy washing-up liquid every two months in large supermarkets. In terms of the major determinants of the product choice, eight themes emerged from the participants' responses. They were (in order of importance) price, smell, efficacy, colour (of packaging or liquid), safety, brand, size and shape of packaging.

7.4.3 Online survey with consumers

The interviews with consumers revealed eight elements that participants considered to be important in their washing-up liquid product purchase decision. In this section, an online survey is described to further explore the importance of the eight elements (price,

smell, efficacy, colour, safety, brand, size and shape) that the interviews had identified.

7.4.3.1 Online survey process

Recruitment of participants

In total, 74 students and school staffs in various fields of design, textile, science, education, transportation, music, psychology, language and culture, geography and law at Leeds University took part in the online survey.

Data collection process

The survey commenced by asking whether the participants had bought a washing-up liquid during the last one-year period. The main questionnaire consisted of 10 questions covering gender, age, living status, purchase frequency, place to shop and important factors for a washing-up liquid. In terms of the online question of selecting important factors among the eight elements (price, smell, efficacy, colour, safety, brand, size and shape), a multiple choice rating type was used and the order of questions was randomised. A copy of the questionnaire is provided in Appendix D4. Survey Monkey[8] was used for online survey creation and distribution.

Data analysis method

Data from the survey were analysed using conventional descriptive statistics quantifying the frequency for the questionnaire criteria. For qualitative data from open-ended questions, a template approach (King, 2012) was used.

7.4.3.2 Results

Altogether, 74 participants took part in the online survey. Table 7.3 presents the participants' profile and purchase tendency for a washing-up liquid product.

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[8] Survey Monkey is a private American company that enables users to build their own online survey (Survey Monkey website, Accessed 1 August 2015).

Table 7.3 Participants' profile and purchase tendency for washing-up liquid

		Frequency	Percent
Gender	Male	31	41.9%
	Female	43	58.1%
Age	25 and under	13	17.6%
	26-35	42	56.8%
	36-45	14	18.9%
	46-55	3	4.1%
	Above 55	2	2.7%
Living status	Multi person non-family household	18	24.3%
	Single person household	18	24.3%
	Family/partner	38	51.4%
Purchase frequency	Every two weeks	3	4.1%
	Every month	24	32.4%
	Every two months	28	37.8%
	Twice a year	13	17.6%
	Other	6	8.1%
Purchase place	Large supermarkets	58	78.4%
	Internet delivery	5	6.8%
	Small shops	9	12.2%
	Other	2	2.7%
TOTAL		74	100%

Table 7.4 shows a summary of what elements participants think importantly when they buy a washing-up liquid product. The responses most frequently mentioned are presented at the top of the list. The result shows that price (70.3%) is the highest and shape of packaging (8.1%) is the lowest. An additional new theme *environment* (10.8%) emerged from the online survey.

Table 7.4 Determinants for washing-up liquid

Determinants	Frequency	Percent
Price	52	70.3%
Smell	40	54.1%
Brand	30	40.5%
Efficacy	28	37.8%
Safety	22	29.7%

Colour (of packaging or liquid)	21	28.4%
Size	9	12.2%
Other (Environment)	8	10.8%
Shape	6	8.1%

Table 7.5 presents the result from the open-ended question of what types of smell participants like or want. Forty participants out of 74 provided particular smells they like or want. The most preferred smell was fruity (36.5%).

Table 7.5 Smells preferred or suggested by participants

Smell	Frequency	Percent
Fruit (Lemon, citrus, apple, grape or berries)	27	36.5%
Flower (Lavender or rose)	10	13.5%
Ocean	2	2.7%
No additives	1	1.4%

Table 7.6 presents the result provided by the open-ended question of which washing-up liquid bands participants use. Twenty-nine participants out of 74 provided particular brand names they use. The brand Fairy (27%) was the most frequently mentioned brand by participants.

Table 7.6 Brand names mentioned by participants

Brand	Frequency	Percent
Fairy	20	27%
Persil	5	6.8%
Ecover	2	2.7%
Sainsbury's	1	1.4%
Morrison	1	1.4%

7.4.4 Comparison of the interview and the online survey

The results from the interviews and the online surveys were compared to draw a conclusion in terms of what factors are important for washing-up liquid. In order to explore relationships of how close the data among interview and online survey are, R-

squared was used which can be seen as a measure of correlation (high R-squared values indicate strong correlation).

The interview and online survey data were compared as shown in Figure 7.3. There was strong agreement (see Figure 7.4) between the two studies (R^2 = 0.69). Therefore, the average of the per cent was calculated. The conclusion can be drawn that price (60.1%), smell (47%), efficacy (38.9%), colour (34.2%), brand (30.3%), safety (24.9%), size (11.1%) and shape (9.1%) are important (with the average score in parentheses). Additionally, a new theme, environment (10.8%), emerged from the online survey.
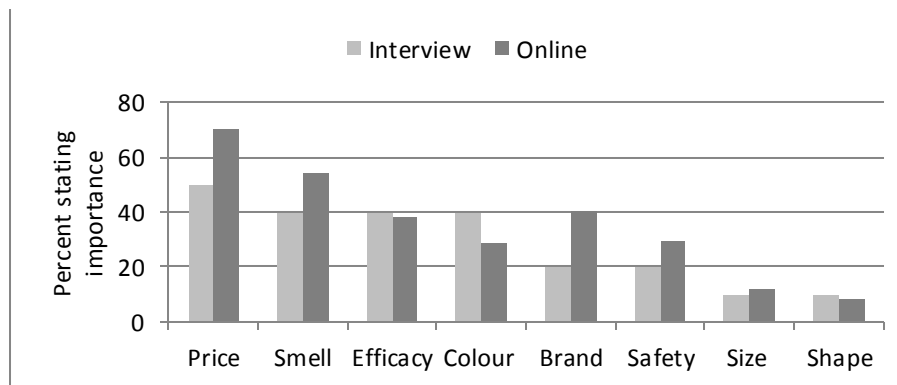
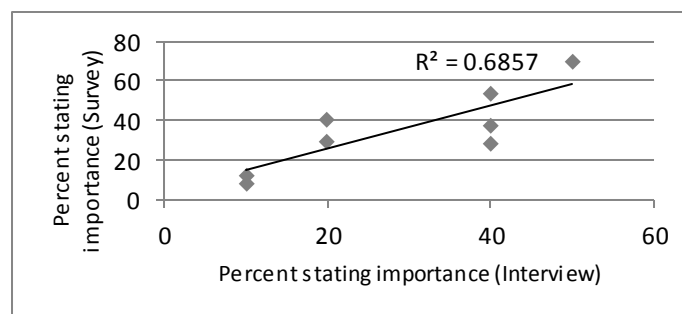*Figure 7.3 Result of face-to-face interview (light grey) and online survey (dark grey)*

Figure 7.4 Correlation between face-to-face interview and online survey results

for each important factors for a washing-up liquid product

7.4.5 Colour meaning experiment

This section conducts a colour meaning experiment to explore colours for washing-up liquid packaging. The review of current UK washing-up liquid products revealed a

generic colour code; deep green for original; yellow for lemon; orange for orange and light green for apple. In terms of colour, it is obvious that yellow, orange and light green are derived from the original substances of lemon, orange and apple. However, the colour of deep green for the original washing-up liquid product is arbitrary. Thus, the following sections explore the extent to which specific greens represent price, efficacy, safety and environment (which have been identified as product choice determinants) using four bi-polar terms – expensive-inexpensive, effective-ineffective, safe-unsafe and environmentally friendly-non environmentally friendly.

7.4.5.1 Experiment process

Recruitment of participants

In total, 25 students (male=9 and female=16) between the ages of 26 and 40 in various fields of design, textile, science, transportation and medical at Leeds University took part in the study. Participants were screened by asking whether they have colour-vision deficiencies.

Selection of colour stimuli and bi-polar words

In the previous studies, price, efficacy, safety and environment were identified as product choice determinants for washing-up liquid. The relevant bi-polar terms of expensive-inexpensive, effective-ineffective, safe-unsafe and environmentally friendly-non environmentally friendly were selected. Figure 7.5 presents packaging ID for the 19 packaging images used for this colour experiment. One particular colour (packaging ID 1) was randomly selected from Fairy's original product which is a leading brand in the product category, and 19 colours were elaborated based on different lightness, chroma and hue ranges.
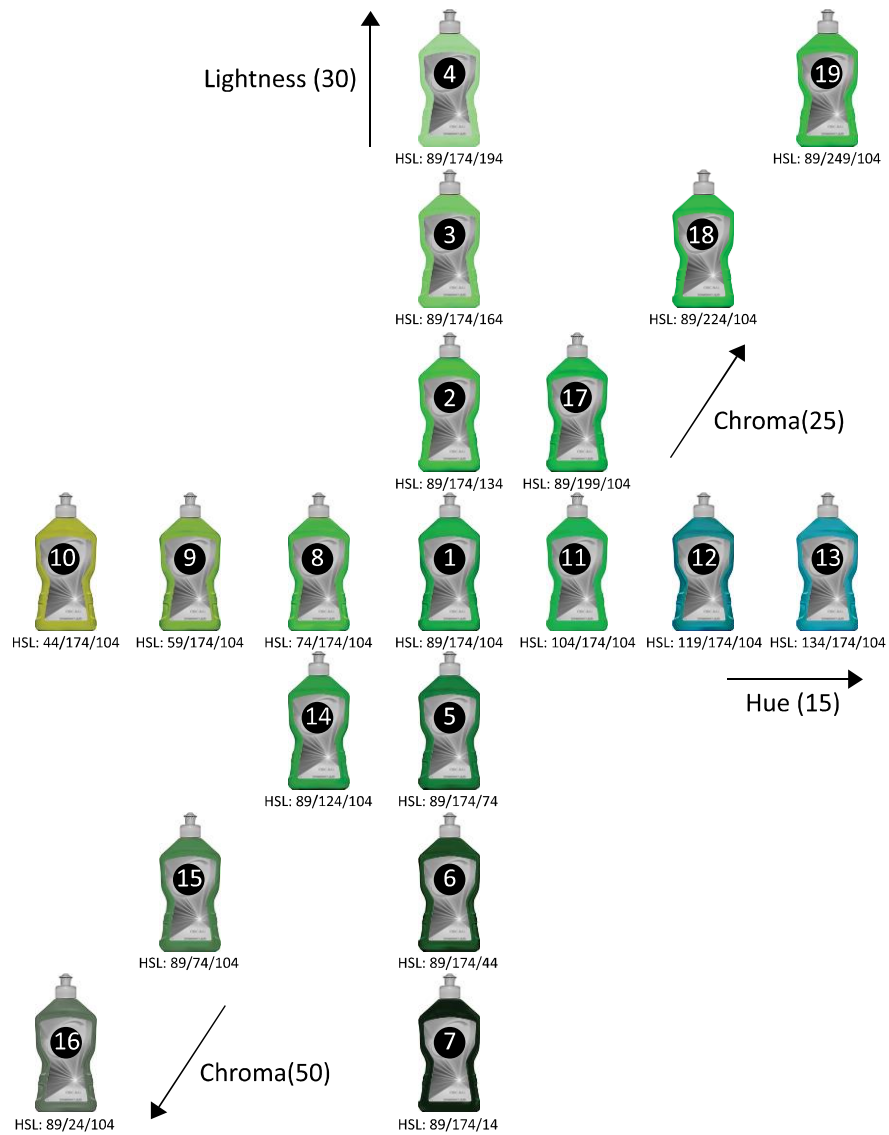
Figure 7.5 Colour stimuli used for this colour meaning experiment

(19 packaging ID with different lightness, chroma and hue variations)

Table 7.7 shows the CIE Yxy values measured with a spectroradiometer (Minolta CS-100A). These values are provided here so that other researchers can understand exactly which colours were used in the experiment.

Table 7.7 Yxy values measured by the spectraradiometer

Packaging ID	Colour	Y	x	y
1		72.5	0.307	0.566

2		117	0.305	0.562
3		143	0.306	0.486
4		168	0.307	0.418
5		36.8	0.306	0.561
6		13	0.309	0.515
7		2.34	0.3	0.388
8		79.9	0.328	0.562
9		86.8	0.371	0.53
10		100	0.418	0.499
11		77.9	0.281	0.487
12		49.8	0.222	0.296
13		64.7	0.216	0.28
14		60.7	0.304	0.519
15		46.4	0.306	0.442
16		39.7	0.313	0.366
17		86	0.306	0.592
18		96.1	0.305	0.586
19		109	0.306	0.595

Measuring method and scale type

A semantic differential-based method using a direct magnitude scale was used to measure people's thinking on washing-up packaging colours. Participants rated 19 packaging images against four bi-polar terms using slider bars as shown in Figure 7.6.

The left-most position was denoted zero and the right-most position was denoted 100 (with the central position being denoted as 50). However, all that is important for the participants is that they understood that the slider bar represented a linear scale between the two terms at each end.
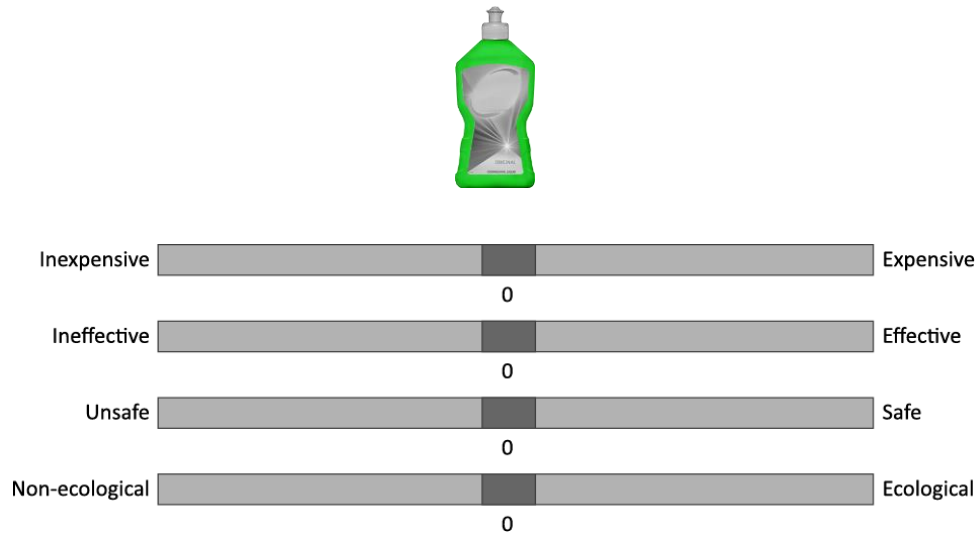
Figure 7.6 A SD based-scale used for this chapter

Process and Venue

All participants were given both written and verbal instruction (Appendix D5) about the task and received an informed consent form (Appendix D3). A dark experimental room (2m x 2m) was prepared. All participants viewed the images with the same computer in the same room.

Data Analysis method

The means of the values for each of the 19 images were calculated.

7.4.5.2 Results

Figures 7.7 to 7.14 present the results for expensive-inexpensive, effective-ineffective, safe-unsafe and environmentally friendly-non environmentally friendly. The largest and smallest mean values are marked with a white colour to make visual inspection of the results easier.

Figures 7.7 and 7.8 show the results that which green colours are the most expensive and inexpensive. The packaging ID 13 was perceived as the most expensive and the packaging ID 16 was perceived as the most inexpensive.
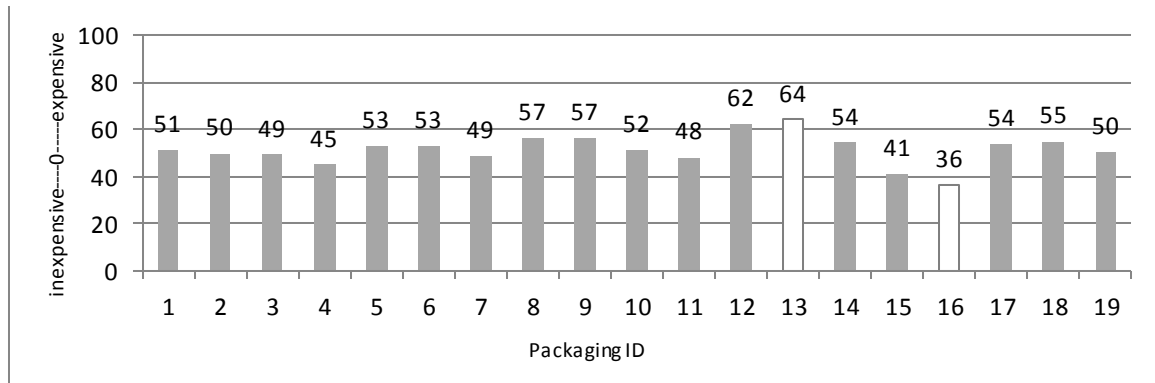
Figure 7.7 Means for the 19 packaging colours in terms of expensive-inexpensive

HSL: 134/174/104   HSL: 89/24/104

Figure 7.8 The most expensive (left) and inexpensive (right) packaging colours

Figures 7.9 and 7.10 show which green colours are the most effective and ineffective. The packaging ID 12 was perceived as the most effective and the packaging ID 16 was perceived as the most ineffective.
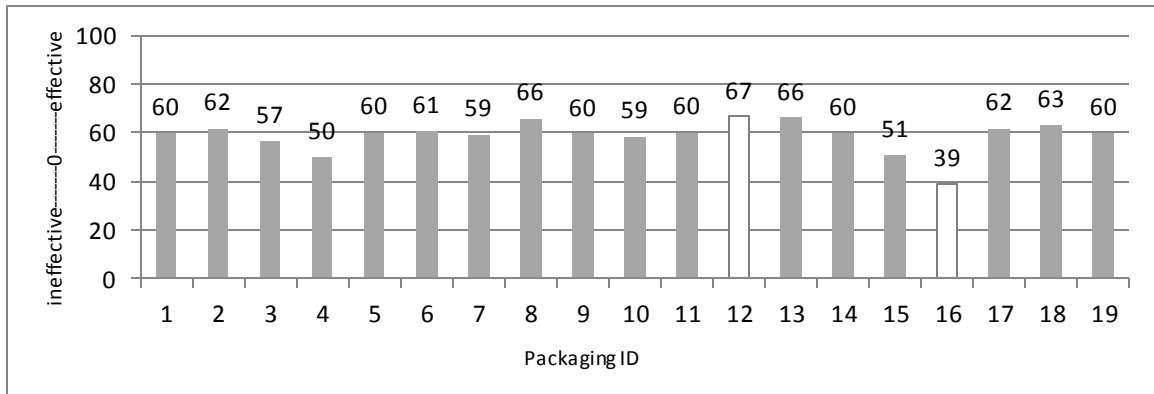
Figure 7.9 Means for the 19 packaging colours in terms of effective-ineffective

HSL: 119/174/104   HSL: 89/24/104

Figure 7.10 The most effective (left) and ineffective (right) packaging colours

Figures 7.11 and 7.12 show the results that which green colours are the most safe and unsafe. The packaging ID 8 was perceived as the most safe and the packaging ID 7 was perceived as the most unsafe.
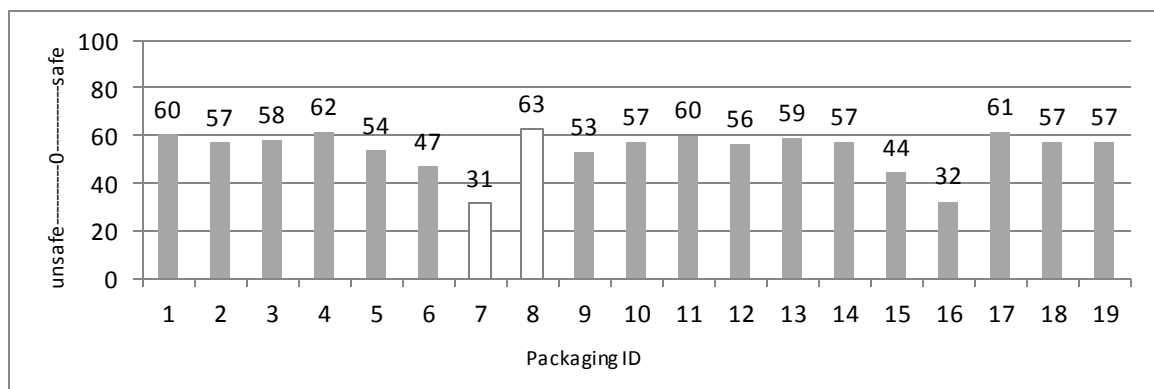
Figure 7.11 Means for the 19 packaging colours in terms of safe-unsafe

HSL: 74/174/104   HSL: 89/174/14

Figure 7.12 The most safe (left) and unsafe (right) packaging colours

Figures 7.13 and 7.14 show which green colours are the most environmentally friendly and non environmentally friendly. The packaging ID 8 was perceived as the most environmentally friendly and the packaging ID 16 was perceived as the most non environmentally friendly.
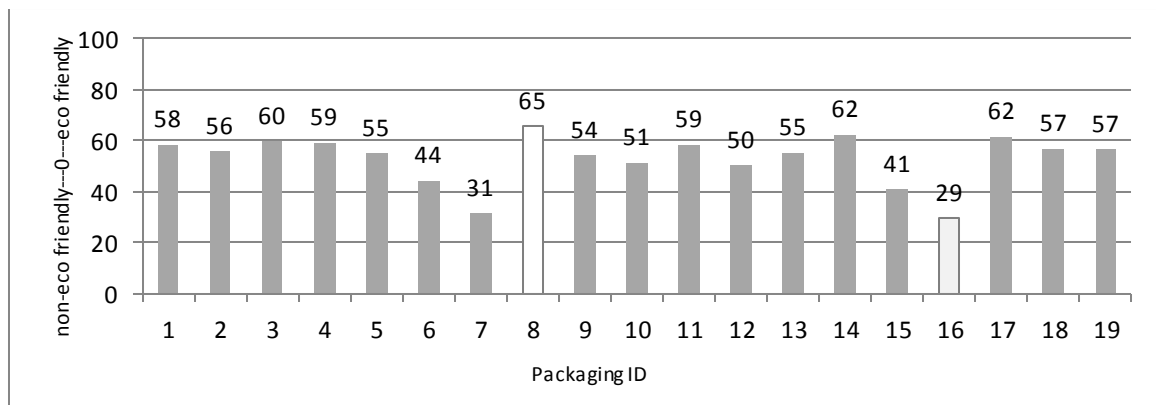
Figure 7.13 Means for the 19 packaging colours in terms of environmentally friendly-non environmentally friendly

HSL: 74/174/104   HSL: 89/24/104

Figure 7.14 The most (left) and least (right) environmentally friendly packaging colours

Figure 7.15 presents a summary of the results from the colour meaning experiment. It showed that a bluish green colour was perceived as effective and expensive. A yellowish

green colour was perceived as safe and environmentally friendly. Dark green was perceived as unsafe and saturated green was perceived as inexpensive, ineffective and non environmentally friendly.

Figure 7.15 Colours for expensive-inexpensive, effective-ineffective, safe-unsafe and environmentally friendly-non environmentally friendly derived from the largest and smallest mean scale values

7.4.6 Interview with a brand manager

This section describes a face-to-face interview with a brand manager to collect opinions for the developed packaging colours and the usefulness of colour meaning information in their packaging development process.

7.4.6.1 Interview process

A single brand manager took part in the interview. He received an information sheet (Appendix D7) and interview questions by e-mail in advance, before the interview was carried out. The interview questions included topics concerning approaches for packaging development, opinions for the developed colours for washing-up liquid packaging, and the usefulness of colour meaning information in their packaging development process. Before commencing the interview, an informed consent form (Appendix D3) was signed by the interviewee. The interview took place in the meeting room of the company, and the interview time was within 40 minutes.

7.4.6.2 Results

The interview provided information on the following three topics: design process, design decision, and value of colour meaning information.

Design process

The beginning of the consumer goods manufacturing company A's general design process was consumer and category research. The goal of the consumer research was to improve the positioning of the brand. In order to achieve this aim, various resources from market research managers, R&D, packaging development managers, semioticians and design agencies were sourced and integrated. The next step was to establish strategic planning and based on this a design brief was created. After nomination of a design agency, design development was executed.

Design decision

The design decision was made differently depending whether it was for an existing brand or a new one. In the case of existing brands, maintaining existing design elements

(e.g. shapes or colours) were significant to make the brands consistent and identifiable. On the other hand, when the company started from scratch to develop a new brand, external experts, semioticians' opinions were taken into account to gain deep understanding of what to communicate through colours, shapes, and typographies, and how to use them to reinforce a brand. The evaluation of whether the product or packaging design was successful was done by consumer online surveys.

Useful value of colour meaning information

In terms of the question of whether this kind of colour meaning information would be useful in their design development process, the brand manager broadly agreed but suggested some additional dimensions in regards to what colours communicate about what the product is likely to smell like. The participant's quote was as follows:

"I think you've done a very good job to identify products' colours. That's one of the pieces of objects we would always need to consider. If we want clear and if we want to achieve something more from the brand or products, we would have specific questions we are trying to decode. So we would commission a specific study, specific questions we would want to answer" (a senior brand manager at a leading UK consumer goods manufacturing company A).

7.5 Discussion

This section discusses key findings for the colour meaning case study conducted in this chapter. After that, the limitations of the methods adopted for the study are discussed.

7.5.1 Reflection on the results of research question 4.2

The colour meaning case study in this chapter was focused on the question of what colour meanings are communicated in a product category – RQ4.2 of this thesis. Washing-up liquid packaging was the somewhat arbitrary focus of the study based on the suggestion of a brand manager in a leading UK consumer goods manufacturing company. Deep insight on colour meaning in the product category was achieved by

collecting multiple data from market research, interviews, an online survey and a colour experiment.

The market research for the UK washing-up liquid products revealed that there was a generic colour code: deep green for original, yellow for lemon and orange for orange and light green for apple. Moreover, differentiated colours were also used. In order to identify important factors for a particular washing-up liquid choice, interviews and an online survey with consumers were conducted. The results of the interviews with participants (N=10) provided eight themes as important factors when participants buy washing-up liquid. These were price, smell, efficacy, colour, safety, brand, size and shape. The results of the online survey with participants (N=74) provided the order of importance for the main determinants for washing-up liquid. The results revealed that price (70.3%) was the highest and that shape of packaging (8.1%) was the lowest. An additional new theme 'environment' emerged from the online survey. In order to make a conclusion for the important determinants, the data from interviews and an online survey were compared. Finally, the importance order was as defined as follows: price (60.1%), smell (47%), efficacy (38.9%), colour (34.2%) brand (30.3%), safety (24.9%), size (11.1%), environment (10.8%), and shape (9.1%). In the colour meaning experiment, the question of which green colours were most appropriate for original washing-up liquid packaging was investigated. Based on the results from the interviews and the online surveys, four elements such as price, efficacy, safety and environment were considered and relevant bi-polar terms (expensive-inexpensive, effective-ineffective, safe-unsafe and environmentally friendly-non environmentally friendly) were used. Participants (N=25) rated 19 packaging colours against the four bi-polar terms. The results showed that a bluish green colour was perceived as both effective and expensive. A yellowish green colour was perceived as safe and environmentally friendly. Dark green was perceived as unsafe and saturated green was perceived as 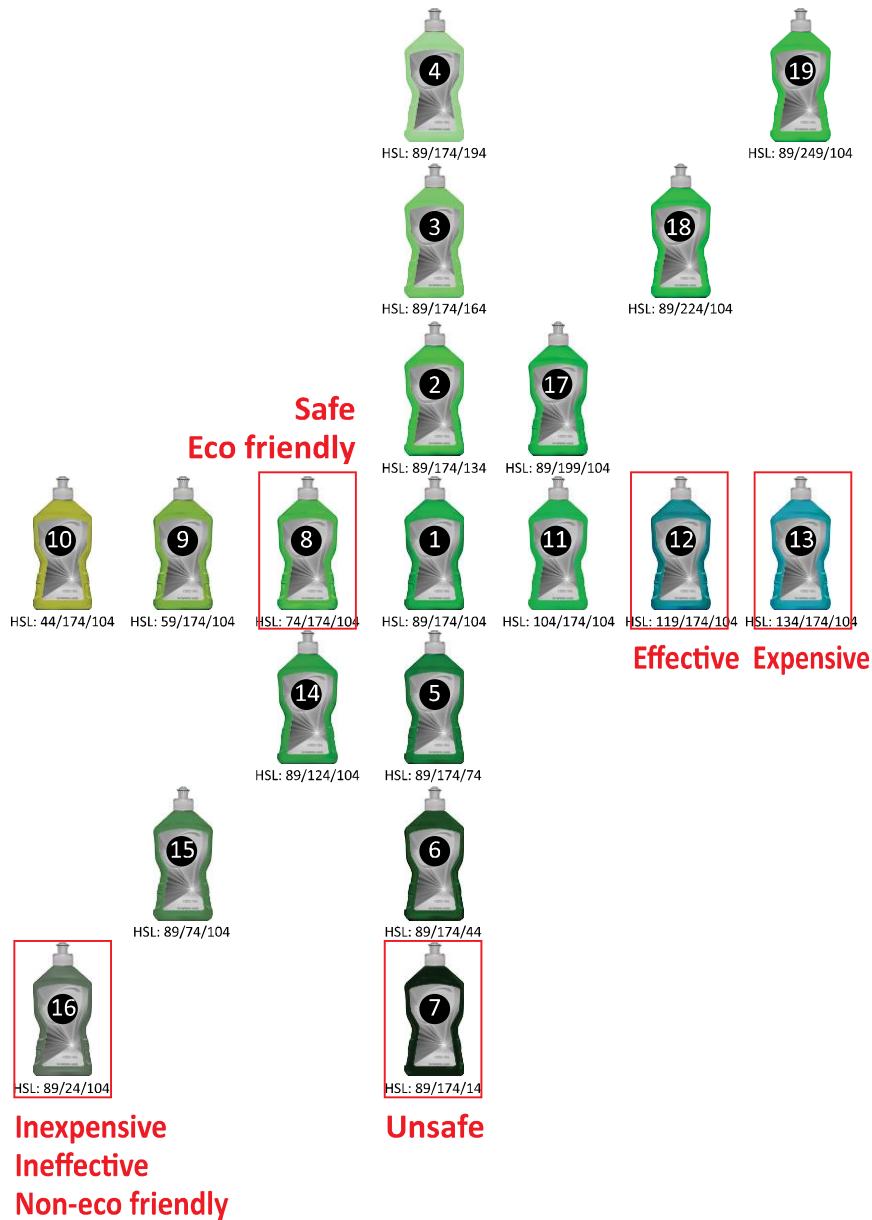inexpensive, ineffective and non environmentally friendly. The developed packaging colours were reviewed by one brand manager in a company. The manager provided opinions that this colour information could be applied in their packaging design and marketing process.

One slightly unexpected result was a tendency for both positive and negative colour meanings in the ways that consumers perceive colours of washing-up liquid packaging. Yellowish and bluish green colours for washing-up liquid packaging were inferred positively such as safe, eco-friendly, effective and expensive whereas saturated or dark green colours were perceived negatively such as unsafe, non-eco-friendly, ineffective and inexpensive. Green is generally associated with positive meanings such as reliable, safe, fresh, natural (Grimes and Doole, 1998), peaceful and gentle (Madden *et al.*, 2000) and health (Kauppinen-Räisänen, 2014). In addition, green/sustainability is an emerging theme that refers to minimal negative impact on the global or local environment (Singh, 2013). However, the results of this chapter indicate that even different green colours may be capable of evoking different consumer reactions. Thus, designer and brand managers should recognise how colours of packaging, logo or product are perceived differently by consumers. In this sense, it is suggested that colour consideration should be done with a thorough understanding of what colour meanings are communicated in a product category.

7.5.2 Critique of the research methods

The limitation of this case study is that only one product category was examined. Validity and reliability would be increased by investigating more product categories by comparing the results with the others.

We should also be aware of the limitations of the scaling technique that was used. Participants were asked to scale colours from, for example, safe to unsafe. Some greens were given much larger scores (tending towards safe) than others. However, this is a relative scale and it is possible that all of the green colours may have been perceived as being safe relative to, say, a red colour. The scaling experiment is able to optimise the colour from those greens that were included and revealed some interesting trends. However, some further analysis would be necessary to enable more robust and absolute statements about the meanings of the colour green compared with some other colours.

7.6 Conclusions

7.6.1 Key insights

This colour meaning case study makes a contribution to the understanding of the colour meanings that are communicated in washing-up liquid packaging. The results show that yellowish and bluish green colours evoke positive responses while saturated and dark green colours are perceived more negatively. There was some evidence from the brand manager (interview) that colour meaning information was useful. The framework that was developed in Chapter 6 was applied and tested by carrying out market research for the UK washing-up liquid products (Section 7.3), and it was shown to be effective.

Colour is a mechanism for creating brand packaging or logos that can arouse positive images. It is obvious that colour is a part of the brand packaging itself as shown in the results of the interviews and the online surveys with consumers in this chapter; the importance of colour was about 34% for washing-up liquid. Nevertheless, as the brand manager suggested in the interview session, colour can support and enhance perceptions for brand associations. In the other words, strategic use of this kind of colour meaning information can offer opportunities in design and marketing promotion evoking or reinforcing particular associations for packaging, logos and products. Thus, the insight from this chapter strengthens the useful value of a colour meaning information in design process and strategy.

7.6.2 Next step

In the next chapter, practice-based research will be conducted to explore the concept for a colour information tool in more detail: RQ5. A prototype of a colour-meaning-centred website (CMCW) will be developed (by the researcher as a designer) based on the findings of Chapters 4, 5, 6 and 7.

Chapter 8
DESIGN AND REFINEMENT

"Design strategy is the effective allocation and coordination of design resources and activities to accomplish a firm's objectives" (Olson et al., 1998, p.55)

The findings of Chapter 4 raised three colour meaning studies. The first was the question of whether colour meanings are affected by context. In order to address this question, a colour meaning experiment (Chapter 5) was conducted, and the implication of the study suggested that colour meanings within product categories would be useful for more sophisticated strategic use in packaging and branding. The second was on the examination of what colour meanings are communicated in a product category. Chapter 6 established a colour meaning framework, and Chapter 7 carried out a colour meaning case study. The results solidify the need for a colour tool development for the better provision of colour-meaning-centred information to design professionals. Based on the insight from the early studies, this chapter attempts to build a prototype of a colour-meaning-centred website (CMCW). The result of this chapter demonstrates the potential for a useful colour tool for professional users in the packaging and branding industry.

8.1 Introduction

This chapter reports on practice-based research to develop a prototype colour tool. The terms *prototype* and *concept* are used synonymously in this thesis as 'prototype' is a commonly used word to indicate an early sample that demonstrates the design features in a website's development (Macdonald, 2003). Based on the informed exploration from previous studies, an initial prototype was developed and refined based on feedback from design professionals (N=8). An e-mail survey and e-mail interviews were conducted to test whether the prototype met their suggestions and to gain additional suggestions. A non-functioning HTML version of a prototype was created for the purposes of this study.

This chapter contains seven sections. Section 8.1 briefly outlines the process of a colour

tool concept development. Section 8.2 presents the aim and objectives of this chapter. Section 8.3 depicts the planned activities to create the prototype. Sections 8.4 and 8.5 illustrate the execution and outcomes of design and refinement studies. Section 8.6 discusses the key findings and study limitations of this chapter. Section 8.7 finishes explaining the propriety and potential of the developed tool concept.

8.2 Aim and objectives

Research question 5 of this thesis will be addressed in this chapter. The aim of this chapter was to explore what concept a colour information tool should take to provide useful colour information to professional users. The devised objectives to achieve the goal are as follows.

1. To generate a design brief.
2. To design an initial prototype.
3. To refine the prototype through evaluation, analysis, and design.

8.3 Prototype development process

A prototype development process was formulated to carry out the concept development work in this chapter. The process involves three steps: the initial prototype design and refinements 1 and 2, as shown in Table 8.1. Central to the process are two cycles of refinement, each of which includes its own evaluation, analysis, and design phase in order to refine the previous prototype. These design activities were planned on the basis of Larman's (2005) iterative model to ensure the application of participants' input to design output, as previously explained in Section 3.5.

Table 8.1 Prototype development process

	Initial prototype	Refinement 1	Refinement 2
Design and research activities	•Design brief •Brainstorming, sketching and wireframing •Prototyping	•Evaluation •Feedback analysis •Design	•Evaluation •Feedback analysis •Design
Outcome	PDF prototype	PDF prototype	HTML prototype

Initial prototype design. Prior to designing an initial prototype, it was necessary to create a design brief. Based on the findings and insight from Chapters 2, 4, 5, 6, and 7, a design brief was established. The design practice began with typical design activities, such as brainstorming, sketching (Aspelund, 2006), and wireframing (Jonathan *et al.*, 2008) for idea generation and visualisation of the tool concept. Through these activities, a PDF prototype was produced as an initial prototype.

Refinements 1 and 2. In order to refine the initial prototype, two refinement studies were carried out. The first prototype was refined based on feedback from designers and brand managers who were drawn from the same interviewees (8 participants out of 10) who participated in Chapter 4. An e-mail survey and follow-up e-mail interviews were used to collect participants' feedback. In order to make participants' suggestions manageable, the 8 participants were divided into either group A or group B. An HTML version of the prototype was developed.

8.4 Initial prototype design

The following sections describe the process and the outcome of the design brief, brainstorming, sketching, wireframing, and prototyping.

8.4.1 Setting the design brief

In order to set up a design brief, the literature review and the findings from Chapters 4, 5, 6, and 7 were carefully reviewed. The literature review broadly characterised existing colour websites (see Section 2.3.5) as having advantages for providing detailed and up-to-date information. However, it also identified some limitations, such as being less reliable when seeking out essential information which can actually be applied to the design process and strategy. Moreover, the key role of colour as a communicator was highlighted (see Section 2.4.2.2). The results of the interview and online survey (Chapter 4) revealed that colour *harmony, perception, meaning, psychology,* and *printing* are particularly important in the packaging and branding industry. In addition, the most preferred tool format was a web-based tool, and various suggestions were collected. The

results of a colour meaning experiment (Chapter 5) showed that some colour meanings are affected by context. The developed colour meaning framework (Chapter 6) provided an understanding of what colour meanings are communicated in a product category. Furthermore, a colour meaning case study (Chapter 7) suggested that colour meaning information could be useful to help design professionals to understand colour meanings for a product category. Figure 8.1 presents the process of building the design brief for the prototype development. The key issues and findings from the literature review and Chapters 4, 5, 6, and 7 are listed on the left of the figure, and the key points of the design brief are outlined on the right.

Literature Review (Chapter 2)	Existing colour tools (section 2.3.5)	Website
		Software
		Mobile app
		Publications
		Colour matching system
	The key role of colour (section 2.4.2)	Colour attracts attention
		Colour communicates meanings
Interview and Online survey (Chapter 4)	Important colour information	Harmony
		Perception
		Meaning
		Psychology
		Printing
	Preferred tool type	Website
	Suggestions	Colour meaning and predominant colour by product categories
		Colour insight or learning
		Colour combinations
		CMYK, RGB, NCS and Pantone code
		Which colour attract attention
		Colour trend
		Individuals' response
		Researched
		Device to match colour from design to print or identify colour on the product
		Regularly updated
		Community site
		Colour psychology
		Inspiring website
Colour experiment (Chapter 5)	Colour meaning in a product category	Contextual dependence and independence of colour meaning
Colour framework (Chapter 6)		What colour meanings are communicated in a product category
Colour case study (Chapter 7)		The useful value of colour meaning information in the packaging development process

Design brief

- Colour meaning
- Website for designers and brand managers
- Package design and branding
- Individuals' responses
- Researched
- Current & past colour palettes
- Shared opinions
- Colour events

Figure 8.1 Design brief development process

Through this process (Figure 8.1), a design brief was developed, as shown in Table 8.2. The focus of the initial concept was to develop a colour-meaning-centred website (CMCW) for professional designers and brand managers in the packaging and branding industry. It was tentatively named 'Colourpedia' as any website needs a name; however, this thesis use the term CMCW to refer to the prototype rather than using the tentative name. The website mainly provides information on colour meanings and the predominant colours in different categories with individuals' responses and researched colour information. Three key constraints were considered for the brief to make the design and refinement studies manageable. First, it must fit within the objectives of the site (colour-meaning-centred). Second, they must be both economically and technically feasible in this PhD completion period. Third, the focus was on the structuring of the website's content in a clear and easily accessible way rather than concentrating on the aesthetic graphics of a site.

Table 8.2 Design brief

	Design brief
Concept	Colour-meaning-centred website (CMCW)
Site's name	Colourpedia
Main focus	Colour meaning
Main user	Professional designers and brand managers
Main design industry	Packaging and branding
What to achieve with CMCW	· Colour meanings and predominant colours in different product categories · Individuals' responses · Researched colour information · Current and past colour palettes · Shared opinions · Regularly updated · Schedules of colour events
Constraints	· Fitting within the objectives of the site · Economical and technical feasibility in the PhD period · Focusing on website's content rather than graphics

8.4.2 Brainstorming, sketching, and wireframing

In order to evaluate the usefulness of a website, Abels *et al.* (1998) suggested six criteria with a ranked order of importance: ease of use, content, structure, linkage, search, and appearance. According to their definition, ease of use is related to navigation; content is the information provided on a website; structure refers to organising site content; linkage is the site links that provide access to relevant information; the search is a list to help search the site quickly, and appearance is the visual aspects of the site. Considering these factors, and in order to respond the design brief, brainstorming, sketching, and wireframing were performed. Brainstorming was intended to obtain various ideas; to do it properly, Jonathan *et al.* (2008) suggested using Post-it notes to organise the ideas. Sketches allow quick and easy corrections to form a site concept (Macdonald, 2003). Wireframes indicate where various elements appear on a site using lines and boxes (Jonathan *et al.*, 2008).

Structure. Figure 8.2 shows the brainstorming activity using Post-it notes and sketches of a structure for the CMCW. The collected data from the early studies were written down on Post-it notes (one idea per note), and similar ideas were gathered together and transformed into a site structure.
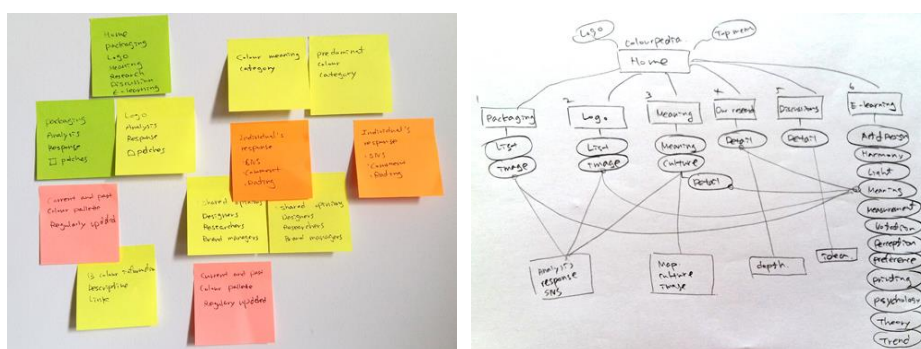

Figure 8.2 Brainstorming and sketching

Figure 8.3 presents a structure for the CMCW. Packaging, Logo, Meaning, Our research, Discussions, and E-learning were labelled as the main menus. The terminology used for the website was mainly from the terms used by participants.
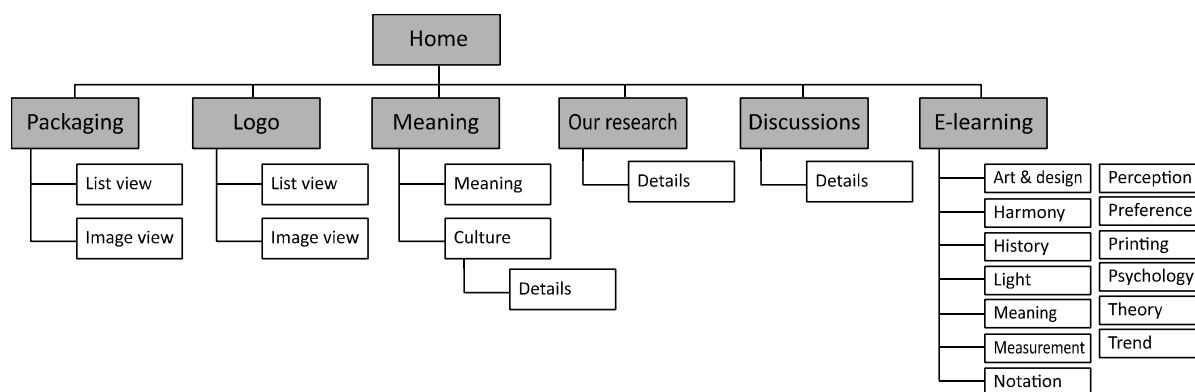
Figure 8.3 A structure for the CMCW

Content. It is suggested that a website's content should meet users' needs (Shayne & Willis, 2002). Based on the suggestions provided by the participants in Chapter 4, 10 web pages were detailed. Table 8.3 presents the wireframes of the 10 pages. They include a home page, 7 second-level pages, and 2 third-level pages. The main menus of the site are Packaging, Logo, Meaning, Our research, Discussions, and E-learning, as mentioned previously. These menus provide detailed contents and navigation that appear on each page.

Ease of use, Linkage, Search, and Appearance. All links for navigation were clearly labelled to allow the site's visitor to easily move to related pages and not become lost. Moreover, the logo was linked to the home page, and the layout of the site information was organised for clear and easy understanding. On the right of a site, a search function was designed to enable a quick search of the site's contents by product categories. The key point of the colour scheme on the site was to determine whether the colours of the background, fonts, and links detracted from the content and were consistent across pages. To emphasise the colour images on the website, white and grey colours were used. According to the participants' suggestions in the previous chapter, they preferred visually engaging and appealing sites, including colour palettes, diagrams, and pictures, rather than textual in data presentation; hence, the concepts were developed in a highly visual way with simple interfaces. The font display was limited to the Courier, Times, Arial, and Helvetica typefaces in a web environment. Thus, Helvetica was mainly used.

Table 8.3 Wireframes showing the layout and elements of each page

· Home page
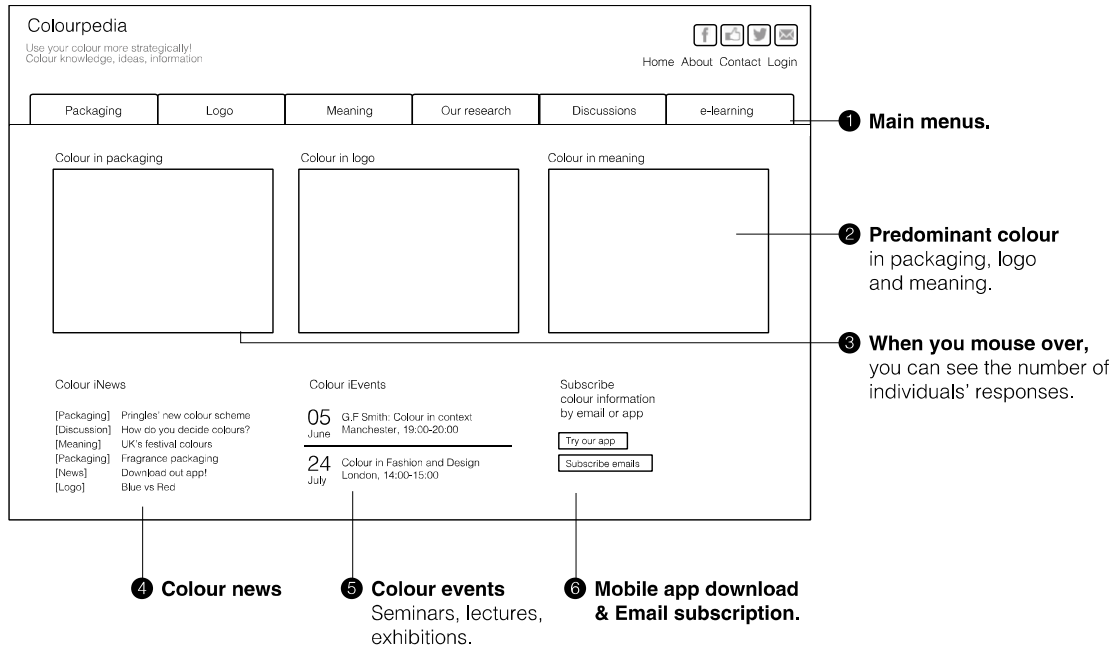
When users move the mouse over the colour patches in the middle of the site, they can see the number of individuals' responses. You can see colour news and schedules of colour events, exhibitions, and seminars.

· Packaging menu
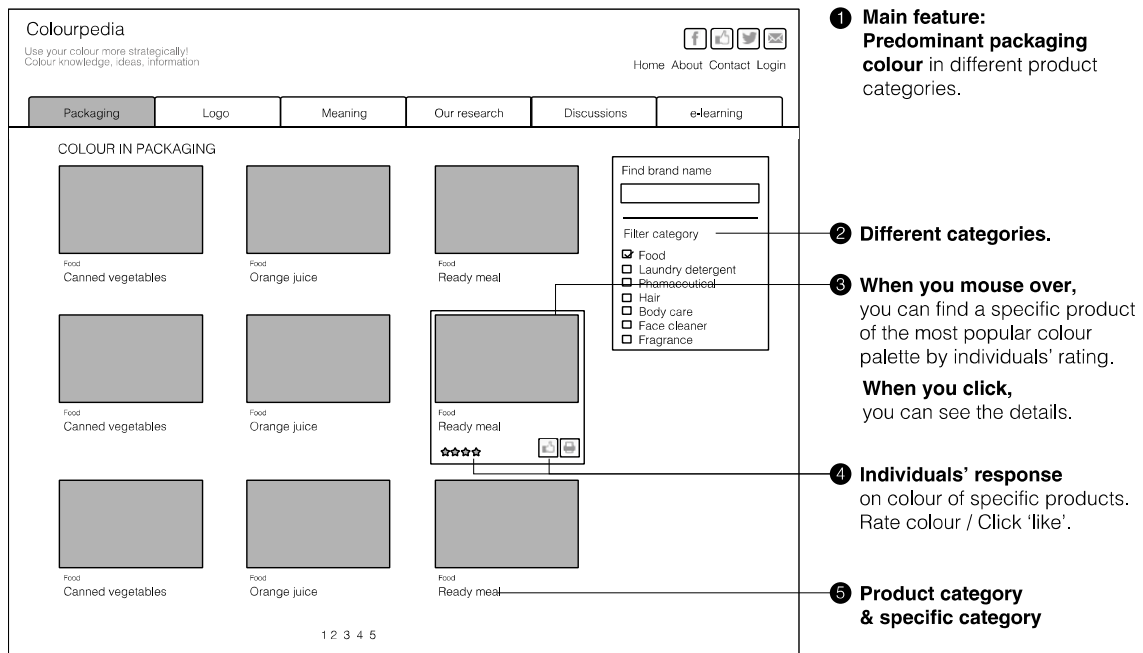
Users can see a list of predominant packaging colours in different product categories with individuals' responses on the colours. When users click one of the colours, they can see the details.

· Packaging menu (Detail page)

Colourpedia
Use your colour more strategically!
Colour knowledge, ideas, information
Home About Contact Login

Packaging | Logo | Meaning | Our research | Discussions | e-learning

COLOUR IN PACKAGING   "Crisps" results 78

Brand name: Walkers (UK)
Colours

Product Image

Love (3) View (2) Meanings (8)
Colour meaning

If you could describe this colour with one word?

pleasant
easy
strong
foodie

Love these colours?
☆☆☆☆

Phlease fogg   Detail
                                    Love (3) View (2) Meanings (8)

Pringles   Detail
                                    Love (3) View (2) Meanings (8)

❶ Main feature:
Detail information
on packaging colour.

❷ List view.

❸ Number of results.

❹ View past colour palette.

❺ Current colour palette,
percent, Pantone code.

❻ Individuals' comments
visualised by wordle.
Yon can see what consumers
think about a product's colour.

❼ Individuals' response
on colour of specific products.
Rate colour / Click 'like'.

❽ Before click 'detail'.
Main colour, product name,
individuals' response.
ex) love (4) view (1) meanings (5)

Users can see detailed colour information for a specific packaging colour (e.g. colour palette, Pantone code, meanings, and individuals' responses). Also, site users can rate colours by clicking 'like'.
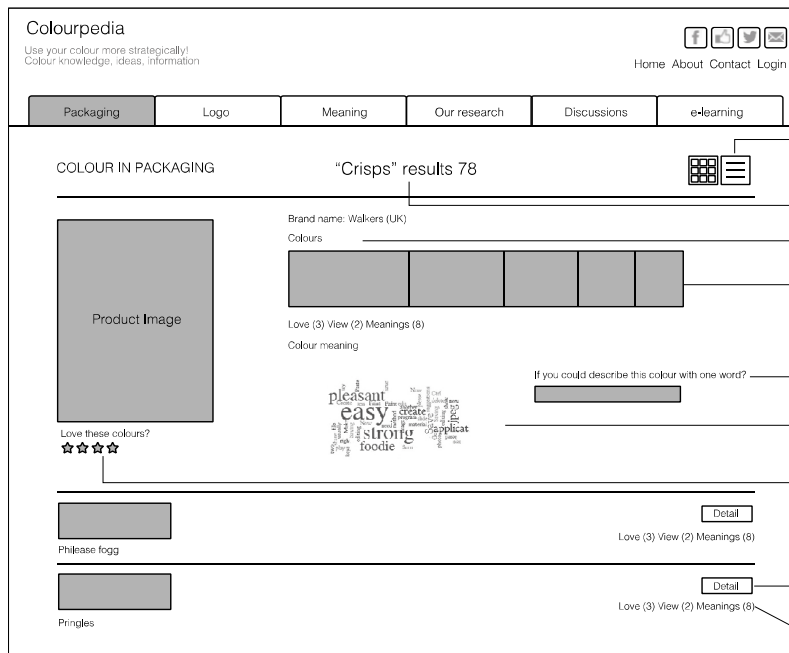
· Packaging menu (Detail page)

Colourpedia
Use your colour more strategically!
Colour knowledge, ideas, information
Home About Contact Login

Packaging | Logo | Meaning | Our research | Discussions | e-learning

COLOUR IN PACKAGING   "Crisps" results 78

Info graphic

❶ Image view

❷ View predominant colour
on a specific product category
at once, **when you click
image view button.**

Users can see colourful and dynamic info graphics for predominant colours in different categories.

Colourpedia

Use your colour more strategically!
Colour knowledge, ideas, information

Home About Contact Login

| Packaging | Logo | Meaning | Our research | Discussions | e-learning |

COLOUR IN LOGO

Electronics
Mobile phones

Electronics
Kitchen Appliances

Electronics
TV & Refrigerator

Find brand name

Filter category
☐ Bank
☐ Electronics
☐ Internet
☑ Home cleaning
☐ Cosmetics
☐ Departments
☐ Fashion

Electronics
Camera

Electronics
MP3

Electronics
Laptop
★★★★

Electronics
Audio set

Electronics
Telephone

Electronics
Game

1 2 3 4 5

❶ **Main feature:**
Predominant logo colour
in different categories.

❷ **Different categories.**

❸ **Detail pages and functions**
are same with
[Packaging menu].

Users can see a list of predominant logo colours in different product categories with individuals' responses on the colours. When users click one of the colours, they can view the details.
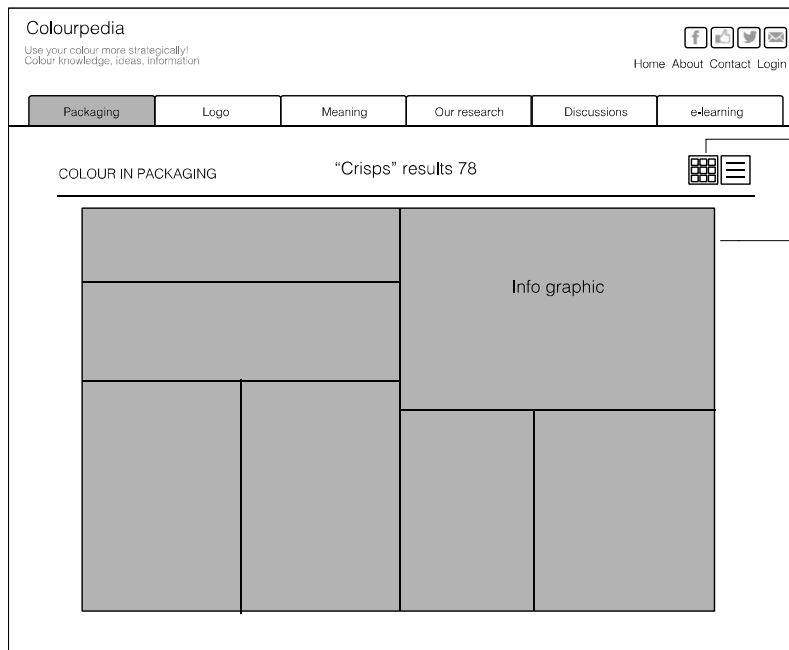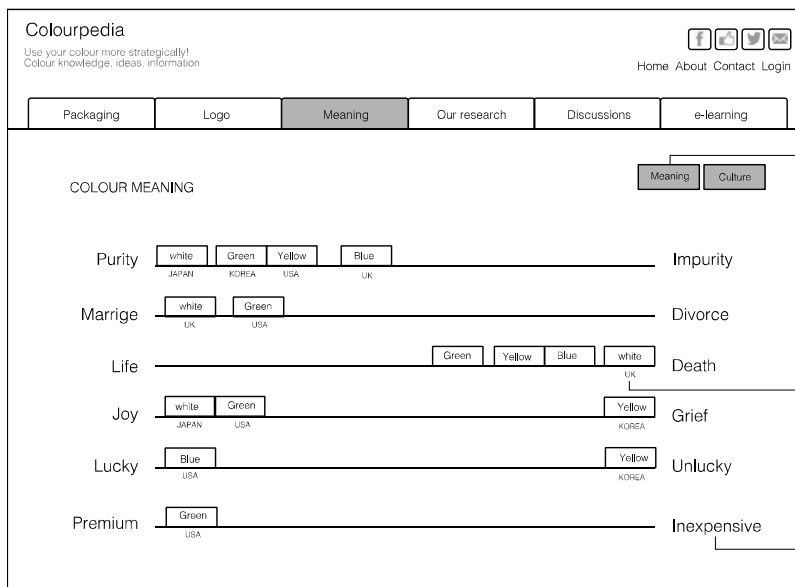
Colourpedia

Use your colour more strategically!
Colour knowledge, ideas, information

Home About Contact Login

| Packaging | Logo | Meaning | Our research | Discussions | e-learning |

COLOUR MEANING

Meaning Culture

Purity — white Green Yellow Blue — Impurity
JAPAN KOREA USA UK

Marrige — white Green — Divorce
UK USA

Life — Green Yellow Blue white — Death
UK

Joy — white Green Yellow — Grief
JAPAN USA KOREA

Lucky — Blue Yellow — Unlucky
USA KOREA

Premium — Green — Inexpensive
USA

❶ **Main feature:**
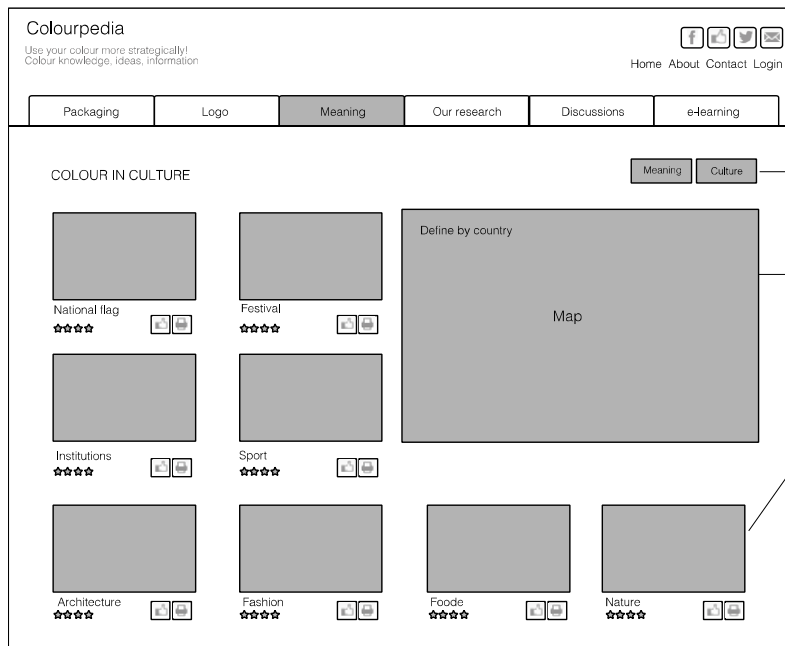**Cross cultural**
colour symbolism

❷ **View meaning**

❸ **Name of countries**

❹ **Bipolar word**

Users can see the result of a cross-cultural colour meaning survey. Colour meanings are shown in different product categories and using different bi-polar words.

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· Meaning menu 2

Colourpedia
Use your colour more strategically!
Colour knowledge, ideas, information

Home About Contact Login

| Packaging | Logo | Meaning | Our research | Discussions | e-learning |

COLOUR IN CULTURE

Meaning Culture

National flag
☆☆☆

Festival
☆☆☆

Define by country

Map

Institutions
☆☆☆

Sport
☆☆☆

Architecture
☆☆☆

Fashion
☆☆☆

Foode
☆☆☆

Nature
☆☆☆

❶ Main feature:
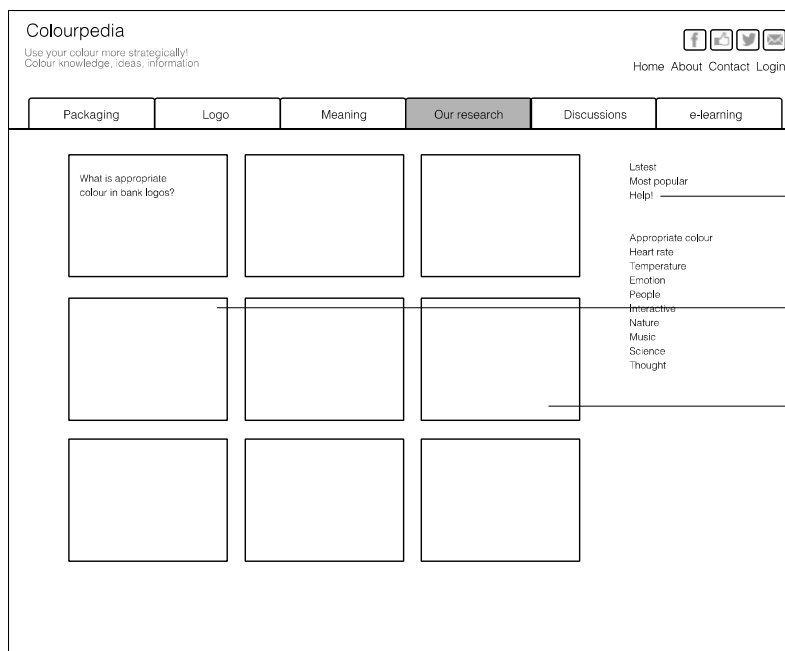**Predominant colour**
in different cultures.

❷ View image

❸ Select one of countries.
you can see relevant colours
of national flag, festivals,
institutions, architecture, etc.

❹ When you click,
you can see relevant pictures
and colour palettes.

When users select one country on the map on the right side of the site, relevant colours of national flags, festivals, institutions, architecture, and food are searched. When users click one of the colours, they can see the details.

· Our research menu

Colourpedia
Use your colour more strategically!
Colour knowledge, ideas, information

Home About Contact Login

| Packaging | Logo | Meaning | Our research | Discussions | e-learning |

What is appropriate
colour in bank logos?

Latest
Most popular
Help!

Appropriate colour
Heart rate
Temperature
Emotion
People
Interactive
Nature
Music
Science
Thought

❶ Main feature:
Researched information
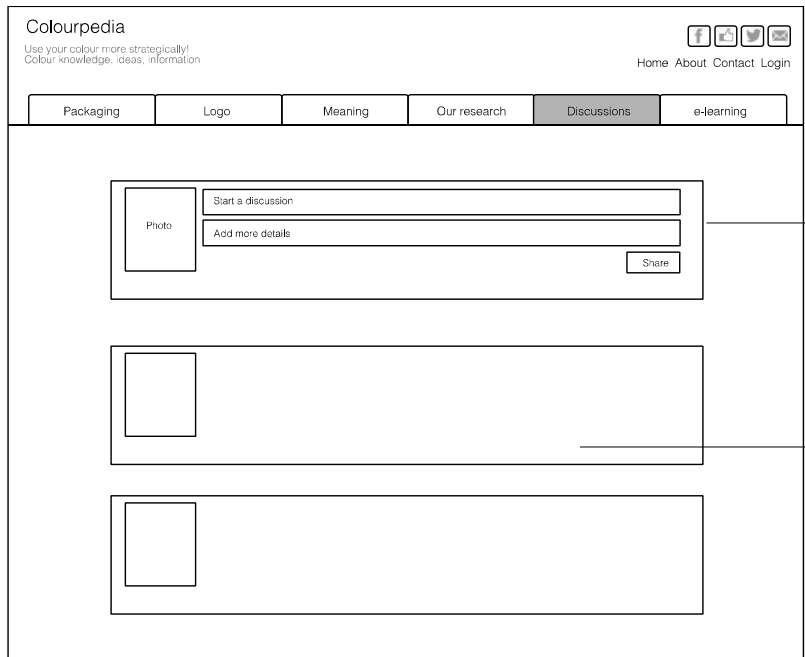**on colour.**

❷ Help!
You can request a specific
colour research / survey.

❸ When you mouse over,
you can see the research
question.

❹ When you click,
you can see **visualised**
information with explanations.

Users can view researched colour information and request research regarding a specific colour.
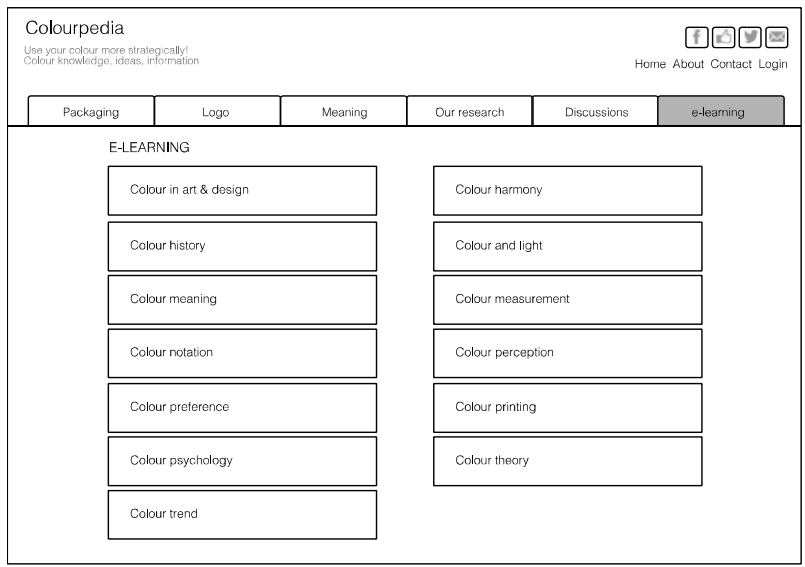
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· Discussions menu

Colourpedia
Use your colour more strategically!
Colour knowledge, ideas, information

Home About Contact Login

| Packaging | Logo | Meaning | Our research | Discussions | e-learning |

Photo

Start a discussion

Add more details

Share

① **Main feature:**
You can share opinions
on colour
with members.

② **Post a topic to discuss.**

③ **Share the opinions.**

Users can share their opinions on colour with other members.

· E-learning menu

Colourpedia
Use your colour more strategically!
Colour knowledge, ideas, information

Home About Contact Login

| Packaging | Logo | Meaning | Our research | Discussions | e-learning |

E-LEARNING

| Colour in art & design | Colour harmony |
Colour history	Colour and light
Colour meaning	Colour measurement
Colour notation	Colour perception
Colour preference	Colour printing
Colour psychology	Colour theory
Colour trend	

① **Main feature:**
Depth information
on thirteen types of
colour aspects.

Users can view an in-depth explanation on 13 types of colour information.

8.4.3 Prototyping

The 10 wireframes were visualised using Adobe Photoshop CS5. One design sample was created rather than two or three design variations. This was because the main focus of the study was the website's content rather than designing a graphically beautiful website, such as moving this button up or down on the web page. Moreover, prototyping was the first step towards finishing the project. The initial concept could have been completely changed depending on the participants' responses in the two refinement studies. Therefore, it was considered that producing one concept would be efficient to save time and effort in developing a first prototype (Jonathan *et al.*, 2008; Boulton, 2009). Figure 8.4 shows 10 pages including the home page and the six main menus. These pages were then transformed in a PDF format, including the concept introduction and a detailed explanation of the main features.
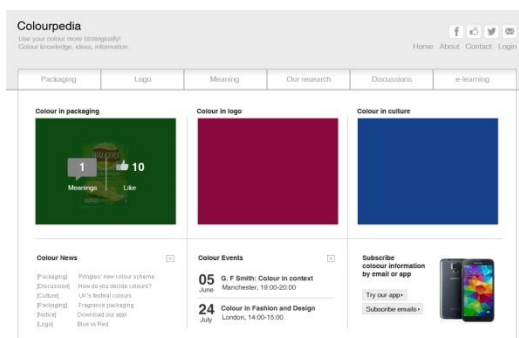

Home

When you mouse over the colour patches in the middle of the site, you can see the number of individuals' responses. You can view colour news and schedules of colour events, exhibitions, and seminars. There is also a mobile app download and e-mail subscription.
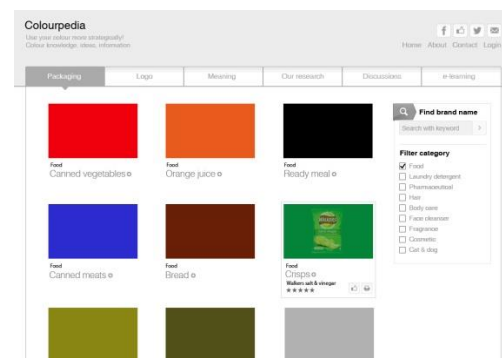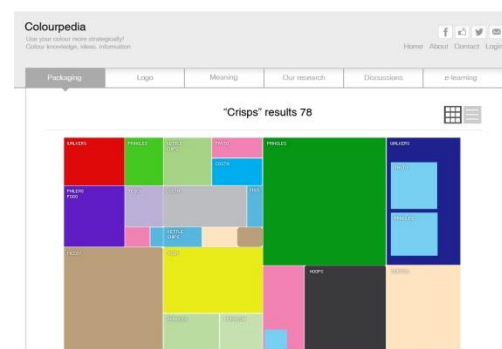

Packaging menu

You can see a list of the predominant packaging colours in different product categories with individuals' responses on the colours.
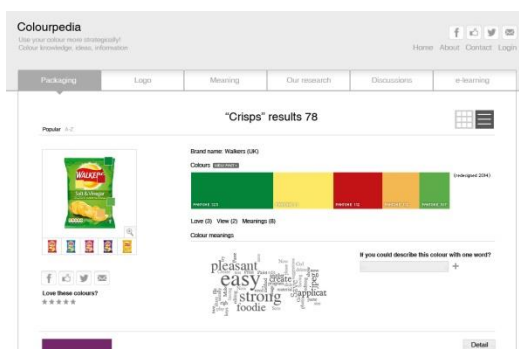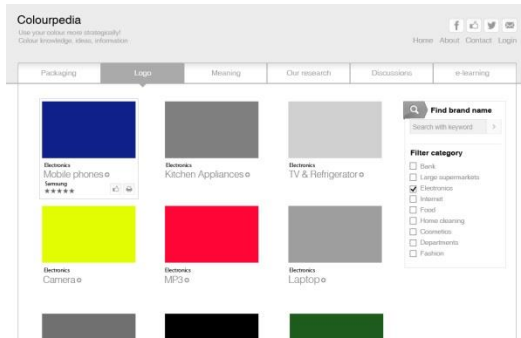
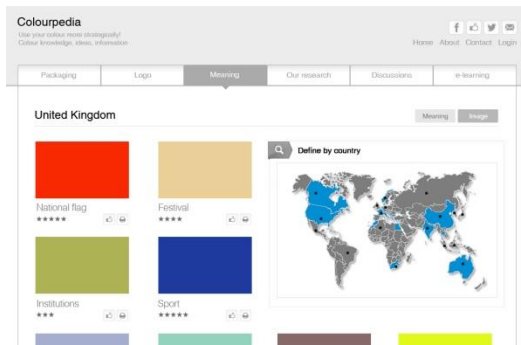

Packaging menu (Detail page)

Packaging menu (Detail page)

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Users can see detailed colour information for a specific packaging colour.

You can see colourful and dynamic infographics for predominant colours in different categories.
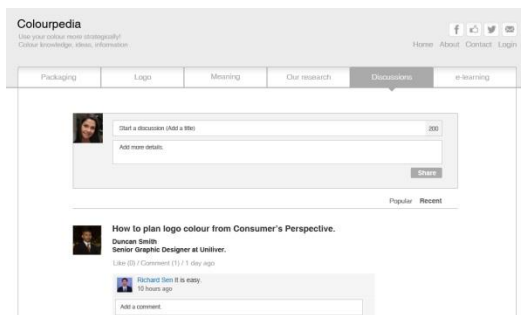

Logo menu

You can see a list of predominant logo colours in different product categories with individuals' responses on the colours.

Meaning menu 1

You can see the result of a colour meaning survey. Colour meanings are shown in different product categories and different bi-polar words.
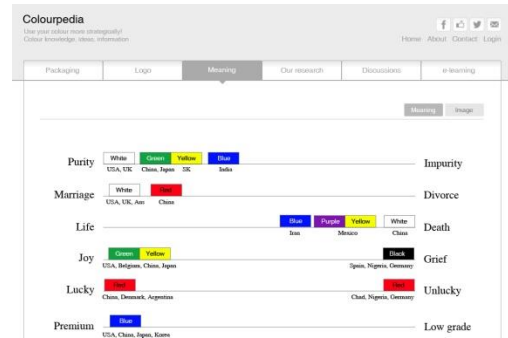

Meaning menu 2

When you select one country on the map in the right side of the site, relevant colours of national flags, festivals, institutions, and food are searched.
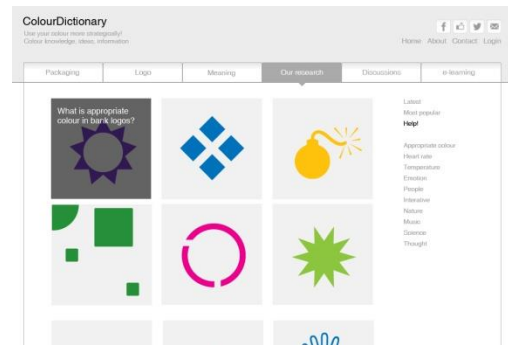

Our research menu

You can see researched colour information and request research about a specific colour.

Discussions menu

You can share opinions on colour with members.
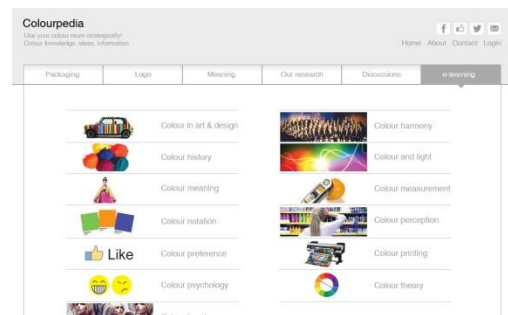
E-learning menu

You can see an in-depth explanation on the 13 types of colour information.

Figure 8.4 An initial prototype design

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8.5 Refinements 1 and 2

The first prototype was used as a data collection instrument for the subsequent refinement studies of the prototype which were aimed at gaining a more detailed understanding of participants' suggestions. Two refinement studies were carried out, and each of them involved evaluation, analysis, and design. The refinement studies were conducted with eight participants; in order to make the suggestions manageable, they were divided into groups A and B. Groups A and B participated in the first and second refinement studies, respectively. The following sections describe the data collection methods, including questionnaire design and participant grouping. Then the survey procedure and methods of data analysis are presented.

8.5.1 Data collection methods

An e-mail survey method was mainly adopted, and follow-up e-mail interviews were conducted in order to elicit detailed additional suggestions. Thus, both qualitative and quantitative data were collected and analysed in this chapter.

• E-mail survey

The aim of the e-mail survey was to check the acceptance of the developed prototype and to collect additional suggestions. An e-mail survey involves sending questions to participants via e-mail (Constantinos *et al.*, 2012). This type of survey has some advantages over face-to-face or telephone surveys because it reduces biasing caused by the existence of the interviewer and allows the respondent more time to think about survey answers (Seale, 2012). Another good point of the self-completed e-mail survey is that it is useful to save time and money when participants are scattered geographically. Considering all of the above, an e-mail survey was selected in order to obtain carefully considered feedback for the prototype.

• E-mail interview

Following the e-mail survey, e-mail interviews were informally conducted involving multiple e-mail exchanges between the participants and the researcher (Meho, 2006). The questions were unstructured to allow the researcher to create questions depending

upon what occurred in the previous e-mail survey (Kumar, 2005). E-mail interviews were chosen for two reasons: to diminish the inherent limitation of the e-mail survey where short or unclear responses might be received (Constantinos *et al.*, 2012), and to enable the research to 'dig down deeper' and ask for detailed reasons when the participants responded 'unacceptable' among three questionnaire criteria (e.g. exemplary, adequate, and unacceptable).

8.5.2 Questionnaire design

Survey questions were developed based on the six criteria (ease of use, content, structure, linkage, search, and appearance) of a website evaluation provided by Abels *et al.* (1998) and usability testing questions provided by Cato (2001) as the main source. However, the key focus of the survey was to examine the acceptance of the prototype's content, ease of use, and appearance, and to collect additional suggestions. Thus, the phrasing, order, and scale type were not identical to Cato's, and they were revised to the version used in this chapter. The final questionnaire consisted of 12 questions with three key criteria; the website's content; ease of use and appearance; and overall opinion (see Table 8.4). A copy of the questionnaire is provided in Appendix E1.

Part A. This part of the survey was concerned with the website's content. Participants were asked four questions: whether the prototype met their previously provided suggestions, if the depth and scope were appropriate, whether the site enhances visitors' interest, and if the website's content is reliable. It aimed to explore whether the developed prototype was heading in the right direction in terms of satisfying participants' suggestions.

Part B. This part of the survey aimed to achieve not only ease of use but also good presentation. Participants were asked six questions regarding whether the design was aesthetically appealing, the menus were clearly labelled, the information was clearly arranged, the colour was consistent across pages, the images enhanced the information, and the fonts were easy to read.

Part C. This part of the survey was concerned with the overall opinion of the site. Participants were asked whether they would recommend the site to others and to provide additional suggestions that had not been mentioned before but were still applicable.

Table 8.4 The structure of the questionnaire and the questions' purposes

	Categories	Purpose of questions	Sources
Part A	Website's content	• Evaluation of the acceptance of the websites' content. • Collection of additional suggestions. *Sub criteria: suggestions, depth and scope, interest and reliability.*	Abels *et al.* (1998); Cato (2001)
Part B	Ease of use and Appearance	• Evaluation of the acceptance of the websites' ease of use and appearance. • Collection of additional suggestions. *Sub criteria: design, navigation, layout, colour, image and font.*	
Part C	Overall opinion	• Evaluation of the overall site and collection of additional suggestions.	

The next step was to decide the type of scales used in the survey. Rating type questions are commonly used when collecting peoples' opinions (Robson, 2011). Thus, a rating type scale was adopted for collecting data regarding the acceptance of the prototype. Jacoby and Matell (1971) claimed that using a three-point scale is adequate to collect directional responses. Thus, a three-point Likert scale was used rather than using a many stepped format, and open-ended questions, such as 'please write your comment' were provided for each part of the survey. The three-point Likert scale included three options, such as 'exemplary', 'adequate', or 'unacceptable'. The direction derived from the result of the survey guided the researcher in regards to what to ask the participants next. For example, when the responses were marked as 'unacceptable', additional e-mail exchanges were carried out to ask the reason why, and then it was refined when it was relevant to the objective of the site.

8.5.3 Grouping participants

Larman (2004) suggested that external stakeholders should not be included to make the changes manageable in a digital tool or system development. Thus, this chapter contacted the same designers and brand managers who were interviewed in Chapter 4. In total, 8 participants out of 10 agreed to take part in this study. The initial prototype was refined twice after obtaining feedback from the participants. In order to make the changes manageable, it was necessary to divide the participants into two groups. One method of doing this is by considering the environment that the website is built for (Troyer & Leune, 1998). The four participants out of the eight currently worked for global brands, and the other four worked for small businesses. Thus, the following participant classification was carried out. Table 8.5 describes the attributes of the two groups of the participants.

Table 8.5 Participant attributes in groups A and B

Group A (4 participants working for big brands)		Group B (4 participants working for small businesses)	
Participant ID	Participant position	Participant ID	Participant position
A	Managing partner	G	Colour consultant
B	Strategy director	H	Creative director
C	Executive creative director	I	Creative director
F	Design director	J	Design director

*Participants' IDs are the same ones that were used for the interviewees in Chapter 4

8.5.4 Survey process

All participants were provided with an e-mail message (Appendix E2), a questionnaire, and an attachment of a PDF prototype via e-mail. The PDF prototype included an introduction of the concept, a detailed explanation of how and why the CMCW was developed, and what advantages can be achieved with the web-based tool. After the completion of the survey, further e-mail exchanges were sent to the participants when their responses were 'unacceptable' for the criteria of the survey and also when the comments were not clear.

8.5.5 Data analysis methods

Data from the survey were analysed using conventional descriptive statistics quantifying the frequency for the questionnaire criteria. For qualitative data from open-ended comments and additional e-mail exchanges were coded and clustered using a template approach (King, 2012).

8.5.6 Refinement 1: Evaluation, analysis and design

The first refinement study aimed to investigate the acceptance of the first prototype and detail additional suggestions from the four participants of group A. The refinement study included three activities; evaluation, feedback analysis, and design, as described in the prototype development process (see Section 8.3).

Evaluation. The participants in group A reviewed and evaluated the prototype by filling out the questionnaire. The main attribute of group A was that all the participants currently worked for global brands.

Feedback analysis. Once the questionnaires were sent back by the participants, the researcher analysed the data. Then, a follow-up e-mail interview was undertaken a) if the feedback was not clear and b) their mark was 'unacceptable'. This informal e-mail interview asked several open-ended questions, such as what their suggestions meant to them and why they thought they were important to their design process.

Design. Additional suggestions collected from group A were examined to select those to be addressed. The researcher determined the changes as a designer within the design brief while also considering the constraints, such as the site's objectives and feasibility which were created in the design brief generation stage (Section 8.4.1). The focal point of the refinement was to improve the quality of the content of the website. Thus, graphic design was less of a focus. Although the changes were made based on the researcher's judgement, another second refinement study was used to ensure the assumptions the researcher had made about the site's development.

8.5.6.1 Result of evaluation

Figure 8.5 presents the results on part A of the survey, including four sub criteria for the site's content: suggestions, depth and scope, interest, and reliability. It aimed to explore whether the developed prototype was headed in the right direction to satisfy participants' suggestions with resource-rich information. The number of participants in group A is four; therefore, this means the maximum is four. The specific questions for part A were as follows:

- Have the suggestions provided by you been met?
- Is the depth and scope of the information appropriate?
- Do the website contents enhance visitors' interest?
- Is the information reliable?

Overall, participants gave a favourable response, answering 'exemplary' or 'adequate' to most of the questions without any 'unacceptable' responses. However, for one question regarding whether the website's content was reliable, two participants did not respond. The open-ended comments explained why the two participants did not give any response for the reliability of the website's content. The reason was because the two participants felt that it was difficult to judge whether the website' content is reliable without an actual, functioning website at that concept in the development stage.
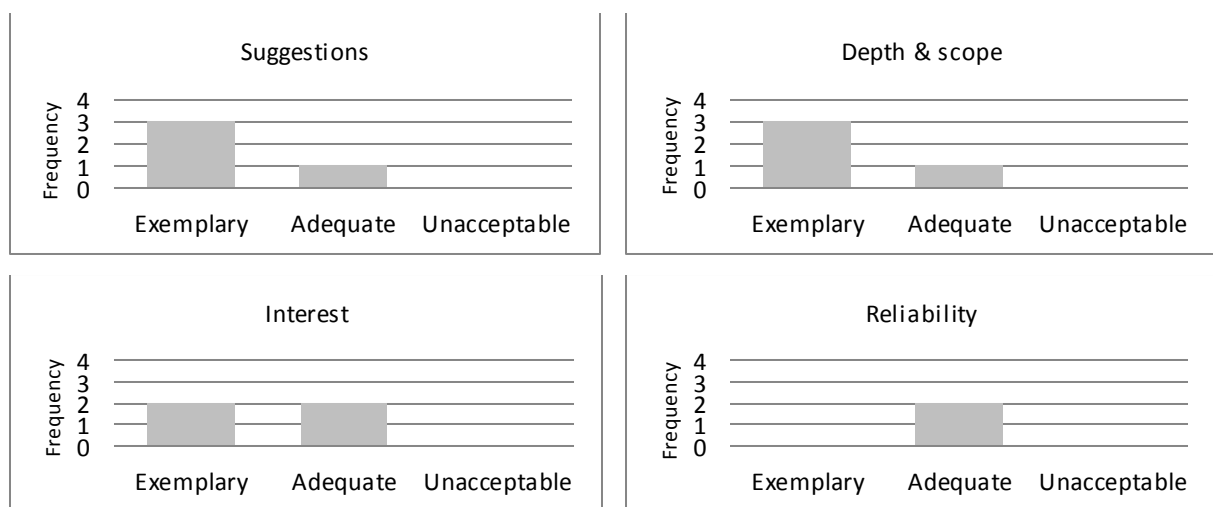

Figure 8.5 Responses on the quality of the website's content (Part A of the survey)

Figure 8.6 presents the results on part B of the survey. Part B included six sub criteria for the ease of use and appearance of the site: design, navigation, layout, colour, image, and font. The specific questions for part B were as follows.

- Is the site's design aesthetically appealing?
- Are links for navigation clearly labelled to allow the user to easily move to related pages and not to become lost?
- Is information organised for clear and easy understanding?
- Do the colours of the background, fonts and links detract from the content, and are they consistent across pages?
- Do the graphic images enhance the information?
- Are the fonts appropriate to read?

Overall, participants gave favourable responses, answering 'exemplary' or 'adequate' to most of the questions without any 'unacceptable' responses.
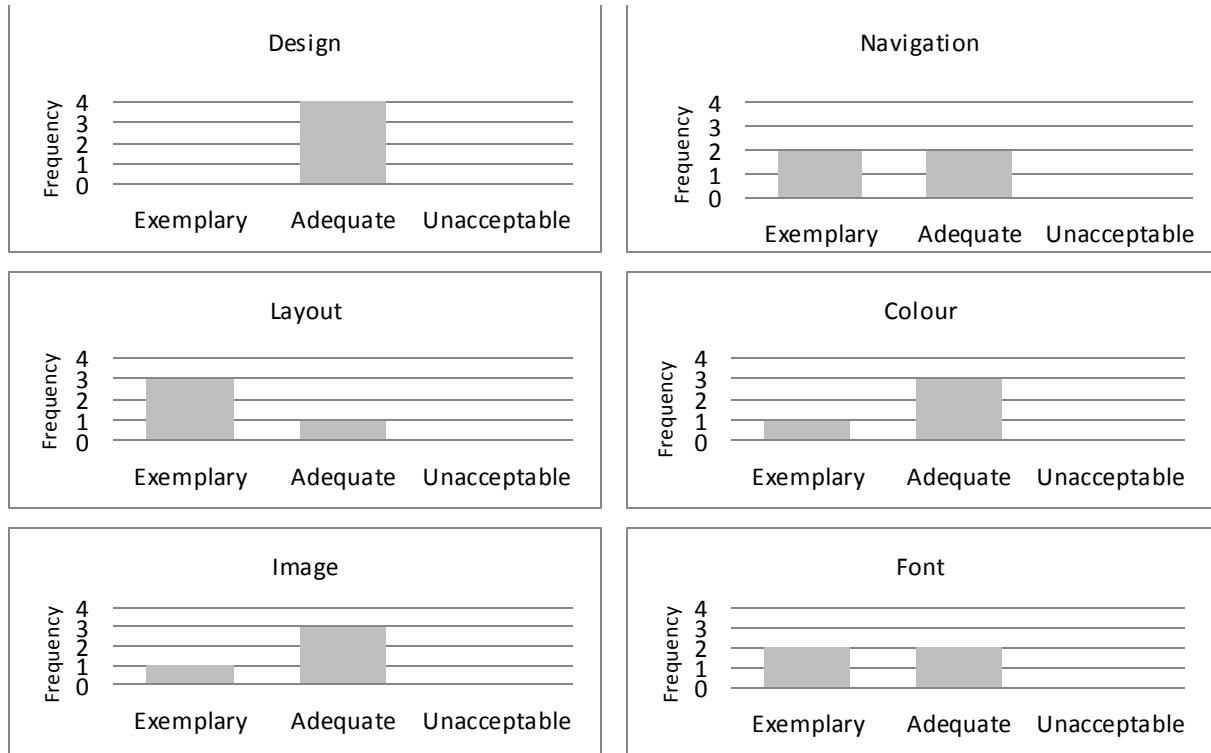

Figure 8.6 Responses regarding ease of use and appearance (Part B of the survey)

Figure 8.7 and Table 8.6 presents the results on the part C of the survey. Figure 8.7 shows the result for a question on whether they would recommend the website to others; 3 of 4 participants gave positive responses.
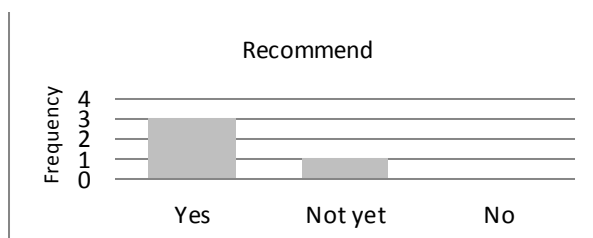

Figure 8.7 Responses on whether participants would recommend

the website to others (Part C of the survey)

Table 8.6 presents quotes made by interviewees in response to the question as follows: 'please write your overall feedback to improve the initial concept'. Positive and negative responses were received, and the following list of quotes had an illustrative rather than an exhaustive perspective. Reviewing these reflections was considered helpful in understanding participants' overall opinions for the prototype.

Table 8.6 Participants' quotes on the prototype (Part C of the survey)

Interviewee	Comment
A Managing partner	"I think this is a really worthwhile initiative".
B Strategy director	"The idea of being able to understand what categories and brands use which colours globally, and what these colours mean, is a very appealing one and one that could be very useful in my industry (branded design)".
C Executive creative director	"To be totally relevant, it needs to have enormous depth and scope".
F Design director	"Great concept. Audits have become a huge part of the design process within the industry, and to have one place to do all these things would speed up the process and save firms money".

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8.5.6.2 Result of feedback analysis

Table 8.7 presents additional suggestions collected from the participants in group A. Each sub criteria of the survey included open-ended questions to gather detailed feedback. Although a majority of the suggestions were concerned with small design changes, such as adding various fonts or buttons, one feedback was concerned with 'colour trend', i.e. the website's content. The key intention of the refinement study was to improve the website's content. Thus, an e-mail interview occurred to ask why the participant wanted to see the 'colour trend as a main menu' on the prototype. The following questions were sent to the participant.

- What does 'colour trend' mean to you?
- Why is the colour trend important to your design or branding process?
- What specific information on colour trends should the colour website provide?

Colour trend meant the following to Participant A: "more specific movements in the prevalence of colours within particular product categories, or relating to particular themes (e.g. luxury, naturalness, etc.)". Colour trends are important to his design and branding process because "the marketing and related design world is always interested (even obsessed) by the future", and "as an element of learning or insight to add into the creative process". Specifically, he wanted a feature like "…to pick up on key categories which in the short and longer term could have an influence on colour preferences and opinions overall (like fashion, cars, home décor)".

Table 8.7 Additional suggestions collected from group A

Additional suggestions
Website's content
· Colour trend as a main menu (more specific movements in the prevalence of colours within particular product categories)
Ease of use and Appearance
· To use varied fonts
· To remove boxes and drop shadows and make type headers bolder
· To remove the grey panel box at the top of the site

· To add a next or previous button towards the bottom of the pages
· To be visually inspiring and colourful
· To use a simple column instead of wordle

8.5.6.3 Result of the design

In the design brief stage, four constraints were formulated in order to conduct a refinement study (in Section 8.4.1). The three constraints were as follows:

- The focus of the website's content is colour-meaning-centred.
- It must be feasible to implement within this PhD project timeframe.
- The main focus is to structure the website's content rather than aesthetic graphics.

The additional suggestions that emerged from the feedback analysis were compared by the present constraints, and then particular suggestions were applied to the redesign. Table 8.8 presents which suggestions were applied to the first refinement. The redesigned prototype was produced in the form of a PDF and sent to participants in group B.

Table 8.8 Refined suggestions from group A

Changes for the initial prototype
Refined
· Colour trend as a main menu (partly applied in the 'our research' menu)
· To use varied fonts
· To remove boxes and drop shadows and make type headers bolder
· To remove the grey panel box at the top of the site
· To add a next or previous button towards the bottom of the pages
Not refined
· To be visually inspiring and colourful
· To use a simple column instead of wordle

The suggestion 'colour trend as a main menu' was partly included in the first refinement study. The follow-up e-mail interview detailed the suggestion as "specific movements in the prevalence of colours" and "pick up on key categories". The researcher assumed that

these types of users' demands on the specific and researched colour information could be covered in the 'our research' menu. Thus, the colour trend was not included as a top main menu as it was not the objective of a site that focused on colour meaning. However, it will be one of the topics on the 'our research' menu. Several suggestions, such as "to be visually inspiring" were not applied to the redesign as they were not the objective of the site.

8.5.7 Refinement 2: Evaluation, analysis, and design

In the second refinement study, the refined prototype in the first refinement study was assessed by the four participants in group B. The main attribute of group B was that the participants worked for small businesses compared to global brands. The purpose and the process preceded in the same manner as the first refinement study.

8.5.7.1 Result of the evaluation

Figure 8.8 presents the results of part A of the survey. In terms of the quality of the website's content, the participants gave favourable responses for the overall criteria, with two or three out of the four participants answering 'exemplary'. However, at this second evaluation, the negative responses of 'unacceptable' appeared in the criteria, such as suggestions, depth and scope, and reliability. The open-ended comments and further e-mail interviews provided the reasons which were analysed in the feedback analysis stage. The number of participants in group A was four; therefore this means the maximum frequency is also four.
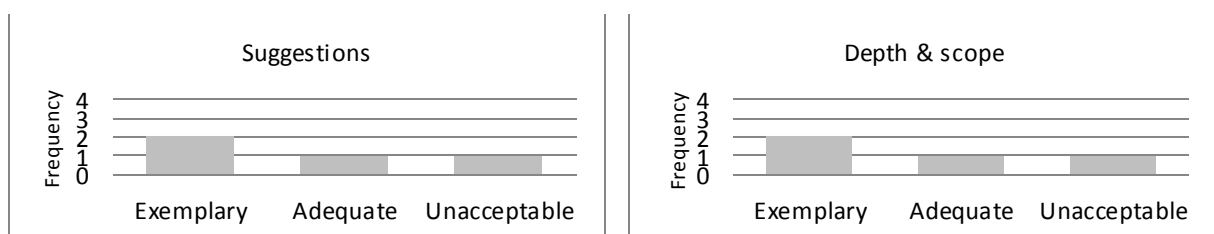
Figure 8.8 Responses to the quality of the website's content (Part A of the survey)

Figure 8.9 presents the results for part B of the survey. In terms of the quality of the ease of use and appearance of the site, participants gave favourable responses answering 'exemplary' or 'adequate' for the all criteria without any 'unacceptable' responses. The design, image, and font criteria in particular were all reported as exemplary. This trend indicated that the quality of ease of use and appearance had been considerably improved by the first refinement study.
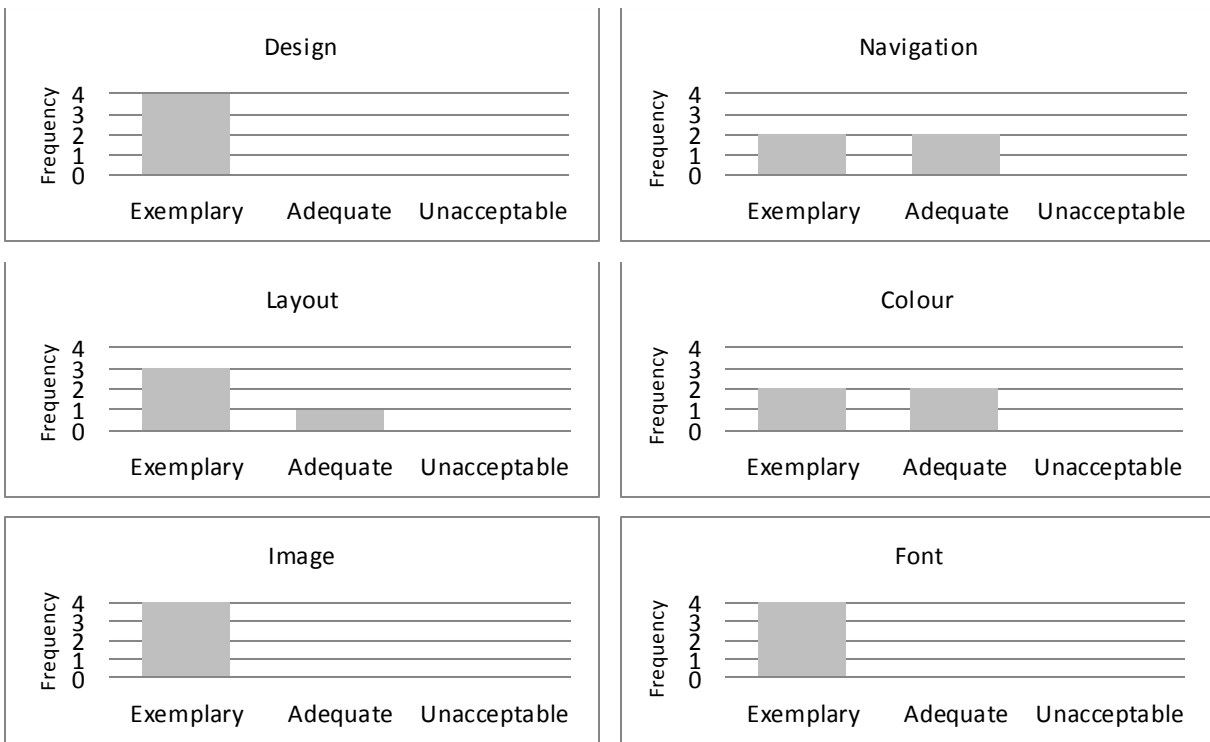
Figure 8.9 Responses regarding ease of use and appearance (Part B of the survey)

Figure 8.10 and Table 8.9 present the results of part C of the survey. Figure 8.10 shows that three of four participants stated that they would recommend the website to others.
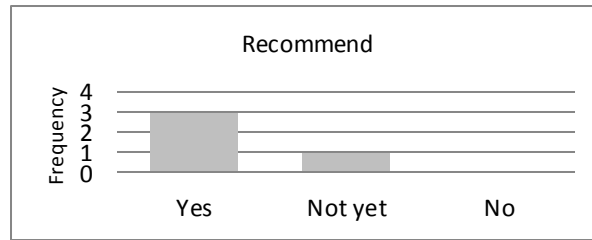
Figure 8.10 Responses on whether participants would recommend

the website to others (Part C of the survey)

Table 8.9 presents the participants' quotes on the question of 'please write your overall feedback to improve this initial concept'. The overall opinions presented favourable responses.

Table 8.9 Participants' quotes on the overall opinions (Part C of the survey)

Interviewee	Comment
G Colour consultant	"Lots of white space is good. It makes it all easy to take in and absorb the information on the screen".
H Creative director	"The site is a great ref for logo or packaging and culture which would be the top searches I as a designer would look for on the internet. A balance between fun and factual would have to be achieved, so that the user would see the site as a reliable source".
I Creative director	"I think this is a really unique take on colour and highlighting the role colour plays in our lives".
J Design director	"Very useful for designers. It is very exciting to learn more about colour".

8.5.7.2 Results of the feedback analysis

Table 8.10 presents additional suggestions collected from group B. The additional suggestions were collected from the open-ended questions for each criterion of the survey. Two e-mail interviews took place to clarify the feedback obtained in this second evaluation stage.

In terms of the first e-mail interview, as mentioned above, the response 'unacceptable' appeared at this second evaluation stage in the criteria, such as for suggestions, depth

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and scope, and reliability. All unacceptable responses were marked by only one participant. The open-ended comments and further e-mail interviews provided the reasons for the participant's assessment. According to her response (Participant G), her low mark was because the prototype presented had not included her suggestion on 'colour psychology'. In order to clarify the comment more thoroughly, the following questions were sent to the participant.

- What does 'colour psychology' mean to you?
- Why is it important to the design or branding process?
- What specific content should the colour website provide to offer the best information on colour psychology?

The results of interviews and online survey in Chapter 4 showed that the relative importance of the 'colour psychology' was behind 'colour meaning'. Based on this, in the design brief development stage, the concept for CMCW was focused on 'colour meaning'. Thus, the participant's opinion on including colour psychology as a main focus for the CMCW was not taken into account for this stage. For the depth and scope of the CMCW, she commented that "I'm a bit confused if this is a professional or a consumer website" (Participant G). This comment was concerned with a website's operative perspective rather than its content or graphic design. Participant G left another low mark for the reliability of the website's content; the open-ended question revealed that the reason was because "it depends on where the information is coming from".

In terms of the second e-mail interview, the unclear feedback was that "I think all I would like to add is a really creative inspiration section" (Participant J). Thus, the participant was asked following questions via e-mail.

- What does 'creative inspiration' mean to you?
- Why is it important to your design or branding process?
- What specific content should the colour website provide to improve the creative inspiration?

According to her answer, 'creative inspiration' meant "something that makes you think in different ways, something that makes you see differently, a different perspective with no boundaries, etc." (Participant J). Her answer also reported that they are important to her design process because "it helps you think, design, and create something that is original and fresh". For the third question, to achieve her demand, she stated that "links to other sites and forums that create a true colour community—or any other way you can think of that explores colour and colour combinations—that have no boundaries". The researcher assumed that her demand for creating a colour community could be covered in the 'discussions' menu. The suggestion, 'links to other sites' was included for all 10 pages at the top menu.

Apart from the comments from these two participants, the majority of the suggestions concerned small changes, such as including some particular themes (e.g. well-being).

Table 8.10 Additional suggestions collected from the first refinement stage

Additional suggestions
Website's content
· To make clear users (professions vs. consumers)
· To clarify cultural colour decision vs. personal preference.
· Other themes (e.g. wellbeing)
· To include psychology
· Creative inspiration section
· Links to other sites
· Add forums
Ease of use and Appearance
· On the culture page, use circles rather than rectangles

8.5.7.3 Results of the design

The additional suggestions that emerged from the feedback analysis were compared by the preset constraints, and then particular suggestions were applied to the redesign. The inclusion of colour psychology was not taken into account as it was not the objective of the site. Table 8.11 presents which suggestions were applied to the first refinement. The redesigned prototype was produced in a form of HTML.

Table 8.11 Refined suggestions in the first refinement stage

Changes for the refined prototype
Refined
· To make clear users (professions vs. consumers)
· To make clear cultural colour decisions vs. personal preferences
· Other colour reference websites
· Other themes like wellbeing
· On the culture page, use circles rather than rectangles
· Include a creative inspiration section (Links to other sites and add forums)
Not refined
· To include psychology

8.5.8 Final prototype

A rendered HTML prototype presents what the final concept looks like. Figure 8.11 depicts the final prototype. The relevant link is http://www.colourpedia.org/index_.html.
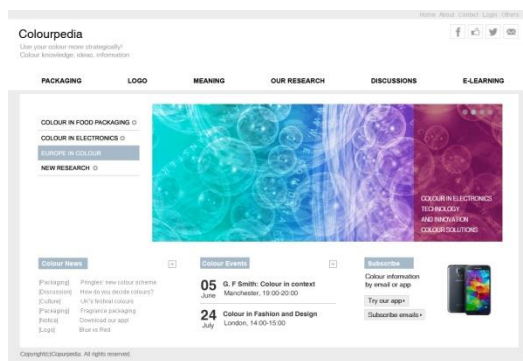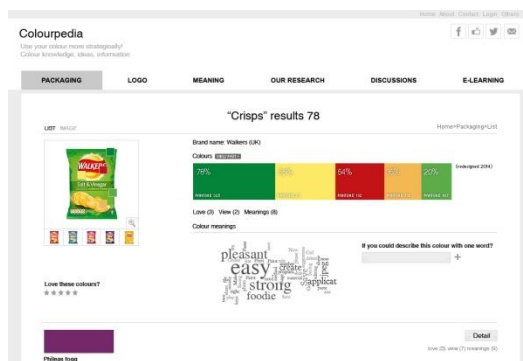

Home
- Colour news/events
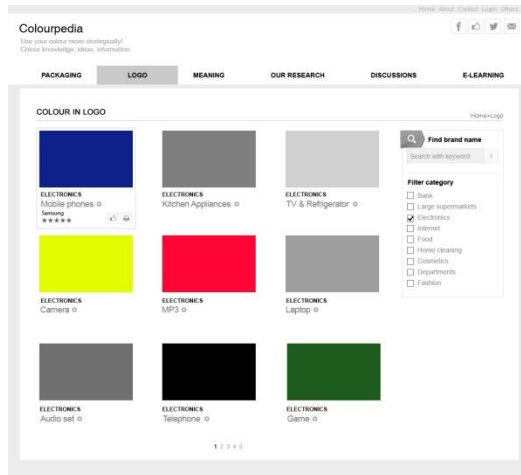- Mobile app download
- E-mail subscription
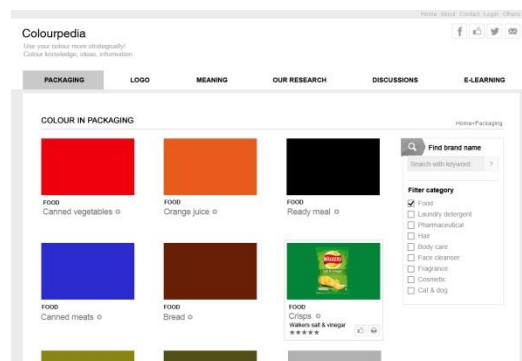
Packaging menu
- Predominant packaging colours in different product categories
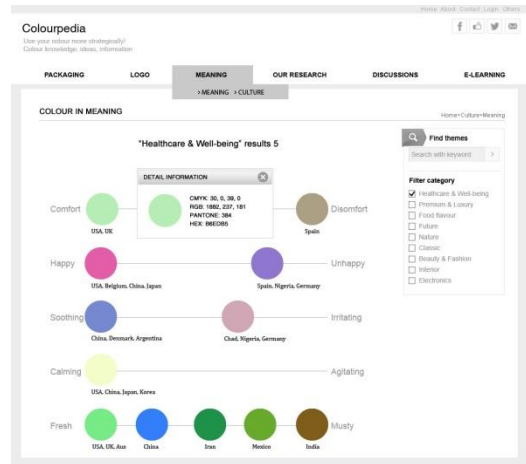- Users' response to the colour of specific products

Packaging menu (Detail page)
- Detailed information on packaging colour
- Past colour palette
- Current colour palette, per cent, Pantone code.
- Users' comments visualised by wordle

Packaging menu (Detail page)
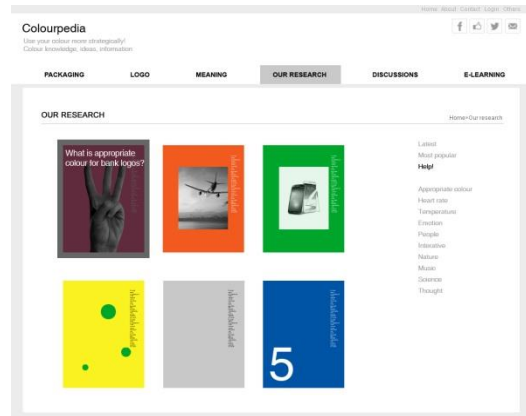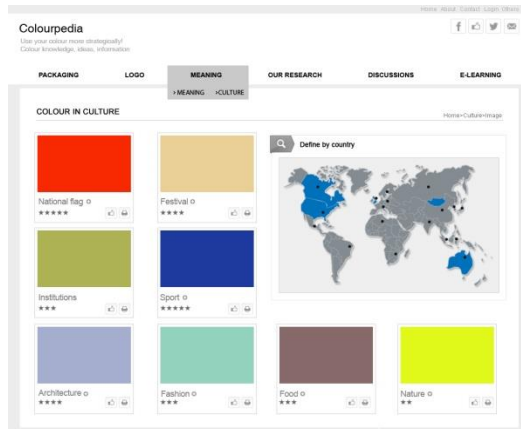- Info graphic to view the predominant colour on a specific product category at once

Logo menu
- The predominant logo colour in different categories
- The detail pages and functions are the same as [Packaging menu]

Meaning menu 1
- Colour meaning in different products and cultures

Meaning menu 2
- Predominant colour in different cultures
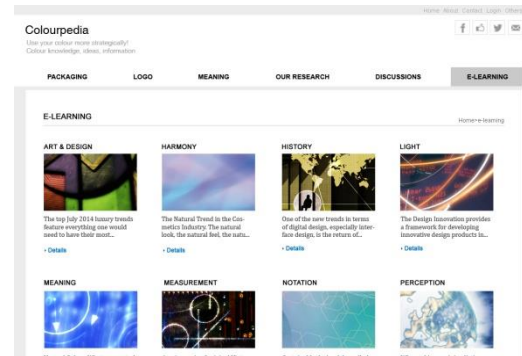- Select one countries. You can see relevant colours of the national flag, festivals, institutions, architecture, etc

Our research menu
- Researched information on colour
  (e.g. more specific movements in the prevalence of colours within particular product categories)
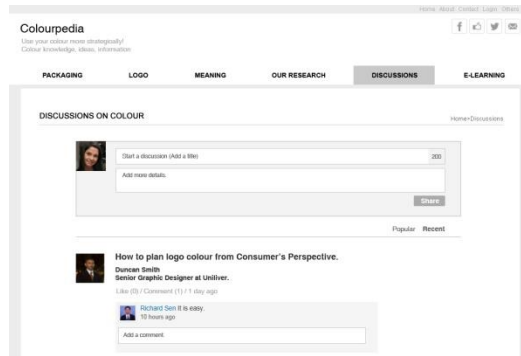
Discussions menu
- You can share opinions on colour with members

E-learning menu
- Depth explanation on 13 types of colour
  Information (e.g. meaning, harmony, trend, etc.)

Figure 8.11 A final HTML prototype

8.6 Discussion

This section discusses the design outcome of the prototype design and refinement studies. After that, the limitations of the methods adopted for the studies in this chapter are discussed.

8.6.1 Reflection on the results of research question 5

The design and refinement studies of this chapter allowed for a focus on what concept a colour information tool should employ to provide useful colour information to design professionals which is research question 5 of this thesis.

In the initial prototype development, the first challenge was to detail the site content. Based on insight from the literature review, interviews, online survey, colour experiment, colour meaning framework, and case study (Chapters 2, 4, 5, 6, and 7), a design brief was first established, and the focus was on developing a colour-meaning-centred website (CMCW). The second challenge was structuring the website with the considerations of ease of use and appearance. It was significant to place various content in a clear and simple manner to make the information easy for users to understand. Ten pages of an initial prototype were produced in a PDF format. A significant aspect of these activities was that both the participants' suggestions and the researchers'

assumptions were applied to the intrinsic characteristic of the prototype. Moreover, in the initial prototype development stage, the researcher only had a limited understanding of what consisted of useful and relevant website information to the users. Thus, using the prototype, two refinement studies were conducted for a more detailed understanding of the content and visual suggestions of a colour tool. The refinement studies were conducted with two groups of participants. These activities were useful to test the acceptance of the prototype's content, ease of use and appearance, and to obtain additional suggestions. The feedback from the participants confirmed that the prototype provided in a PDF met their suggestions. Also, their comments illustrated that the prototype would be useful in the support of enhancing colour insight and saving time and energy. However, some participants wanted a more fully working site for the prototype. Finally, the outcome was created in an HTML format.

To sum up, the design and refinement studies detailed the prototype in a real-world design context and provided the potential that this kind of tool could be useful for professional users in packaging and branding. The developed CMCW can offer many advantages. The key features that it can provide are as follows:

- Colour meaning and predominant colours in different categories.
- Researched information and shared opinions.
- Individuals' responses on the current packaging and logo colours.
- Visual, interactive, easy, and up-to-date colour information.

8.6.2 Critique of the research methods

An e-mail survey and follow-up e-mail interviews were used for collecting feedback from participants. The e-mail survey was useful in allowing participants enough time to consider the prototype and was helpful for the researcher to determine which criteria were acceptable, adequate, or unacceptable, thus reducing bias (Gable, 1994). Also, this survey allowed for a relatively accurate prediction of the participants' acceptance level of the prototype so that the prototype design task was dealt with more effectively. In addition, e-mail interviews were useful to clarify the participants' feedback. However,

despite these advantages, e-mail survey and e-mail interview methods have a typical limitation in that the time periods of data collection could vary (Meho, 2006). Some participants might spend several months, while others could take only a week. Generally, the lengthy of data collection for this chapter took one month. Moreover, due to the lack of direct interaction between the researcher and the participant in e-mail-based surveys or interviews, miscommunication could have occurred (Robson, 2011). To avoid that, the prototype was produced in a PDF format with detailed explanations.

8.7 Conclusions

8.7.1 Key insight
The aim of this chapter was to explore a colour tool concept intended to deliver useful colour information to design professionals. A more detailed understanding of a colour tool was gained.

Delivering useful colour information. As outlined in the literature review, existing colour information is comprehensive. Chapter 4 identified five types of colour information (i.e. colour harmony, perception, meaning, psychology, and printing) which are considered to be useful and important for design professionals in packaging and branding. In order to make it even more useful, the focus of this design project was to create a web-based tool to deliver colour meaning information to users. Participants' feedback presented a need for this kind of information (colour-meaning-centred), and the general reaction of the participants provided encouraging responses. Participants remarked that this type of tool is "unique" (Participant I) and "very useful" (Participant F) which speeds up the process and saves firms money when accessing colour information.

Content. Chapter 4 revealed that design professionals desire colour information in either a formal or an informal and also a sharable sense. To respond to this distinction, the prototype consisted of two streams: one provided information in a professional manner, while the other presented the information in a fun, flexible, and sharable way. The

results of the design and refinement studies indicated that colour-meaning-centred information has the potential to serve as a useful resource when designers are faced with a project that requires colour to be considered. In other words, when they use the tool as a database, they gain access to research and explicit information which is relevant to their current project. Several participants' comments illustrated that "the site is very factual and does answer the need of a designer hard at work who wants to find information to help on a design project" (Participant H), and "this is a really unique take on colour and highlights the role colour plays in our life" (Participant I). At the same time, informal and sharable information can be sourced in the general design process. Specifically, using the tool, users can share interesting ideas and look for colours across different categories. One participant's feedback described that "designers love to play and have fun with their work. The site may benefit from a fun element, and this would help keep the designers' interest in coming back to the site" (Participant H). Moreover, one comment from participants helped further the understanding of how designers want to use "sharable colour information" (Participant A).

Suitable access. A web-based format was chosen for the prototype as it was the most preferred type of tool identified in Chapter 4. According to the results in this chapter, the prototype provides information in a highly visual, interactive, and easy manner and is therefore relevant to the design professionals' preferred method of working.

8.7.2 Next step

In the next chapter, the final prototype will be evaluated by experts in colour, graphic design, and branding areas.

Chapter 9

EXPERT EVALUATION SURVEY

This chapter reports on the expert evaluation survey for the CMCW prototype that was developed in Chapter 8. An e-mail survey was carried out amongst experts (N=8) in the colour, graphic design, and branding fields. The results of the survey confirmed the appropriateness and usefulness of the developed prototype to support design professionals in packaging and branding.

9.1 Introduction

Expert evaluation is one of the most important dimensions to be considered when assessing a website (Macdonald, 2003; Ip *et al.*, 2011), as their experience and knowledge is useful to improve the usability (Korhonen *et al.*, 2009) and to determine the propriety of the developed system (Moustakis *et al.*, 2009). Although there is no universally accepted definition for website evaluation, and techniques are also varied (Law *et al.*, 2010), the US Department of Health and Human Services (2006) broadly characterised the term and the process as ensuring that a website offers useful content and is also easy to use. A survey is one of the most common research methods and provides a straightforward approach to the study of attitudes and motives (Robson, 2011). Thus, this chapter carried out an expert-based e-mail survey in order to assess the CMCW prototype. One senior manager at Pantone (a leading American colour company) and seven academics in colour, graphic design, and branding took part in this survey via e-mail. The self-reported data gathered through the e-mail survey provided both quantitative and qualitative data. At the end of the chapter, how the developed prototype can contribute positively to design professionals in packaging and branding and what features should be further improved are discussed.

This chapter consists of six sections. Section 9.1 summarises what the expert evaluation

survey intended to achieve. Section 9.2 presents the aim and objectives in regard to the survey. Section 9.3 describes the process of setting up the survey, including the questionnaire design, participant recruitment, and methods of data collection and analysis. Section 9.4 presents the results of the survey. Section 9.5 discusses the key findings and study limitations of this chapter. Section 9.6 outlines conclusions and research implications.

9.2 Aim and objectives

The aim of the survey was to evaluate the developed prototype by collecting experts' opinions. This aim was broken down into the following objectives:

1. To evaluate an HTML version of the CMCW prototype.
2. To detail additional suggestions that were not included in the PDF prototype.

9.3 Setting up the survey

In order to conduct an expert-based evaluation of the prototype, this chapter employed an e-mail survey method. These surveys have many advantages, such as allowing participants enough time to answer questions at their leisure and global access (Constantinos *et al.*, 2012). The viewpoints of a panel of experts (N=8) scattered around the world in the US, UK, Korea, and Taiwan were collected. The following sections present the details on the data collection instruments, participants and data analysis method.

9.3.1 Data collection instruments

In order to carry out the expert evaluation survey, a questionnaire and a web-based tutorial with specifications of the prototype were prepared.

There were two primary goals of the survey in this chapter. The first was to evaluate the prototype: more specifically, to assess the clarity, acceptance, and useful value of the

prototype. The second was to collect additional suggestions that were not found in the PDF prototype. Based on these survey objectives, three broad categories were devised: overall opinions; website content, ease of use, and appearance; and comparison between three existing colour websites and the CMCW (Table 9.1). Then, the sub criteria within each category were specified to assess each category. The website evaluation questionnaire was developed on the basis of literature on usability. The questionnaires and criteria from the studies of Abels *et al.* (1998), Elling *et al.* (2012), and Cato (2001) were used as the main source, and the questionnaires were revised to the version reflected in this chapter. Various rating types were used, including open-ended, polar choice, multiple choice, and direct quantifying questions. A copy of the questionnaire is provided in Appendix F1.

Part A. This part of the survey aimed to evaluate the clarity and useful value of the prototype and to collect any additional suggestions for the website. The participants were asked eight questions on their overall opinions, first impression, the clarity of the website's purpose, its strengths, its weaknesses, types of support, useful menu, and any additional features. Four of these questions were open-ended. One question was a polar question, and three questions were multiple-choice. The polar and multiple-choice questions included an open-ended question to elicit the reasons for the choices.

Part B. This section of the survey was developed to evaluate the acceptance of the prototype. Participants were asked 10 questions on the quality of the website's content, ease of use, and appearance. Direct quantifying type questions were used to determine the attitude of the participants. A slider bar with a scale from 0-100 was included so participants could indicate how acceptable they found the prototype (where 0 = of no value, 50 = acceptable, and 100 = exemplary). Figure 9.1 shows the slider bar used in this survey. For each main criterion, an open-ended question was also included where participants rated any of the questions below 50 points.

Figure 9.1 The slider bar indicating the value between 0-100

Part C. This part of the survey aimed to evaluate the useful value of the prototype. The participants were provided with four websites (three existing colour websites and the CMCW), and they were asked to compare them to each other and rate them. A traffic counting website (Alexa.com) was used to select the three existing colour websites as website traffic reveals how many users visit a particular website over a certain period of time (Ip *et al.*, 2011). The selected colour websites were Pantone, Kuler, and Colour Lovers. A direct magnitude scale was used for the survey, and a slider bar with a scale from 0-100 was included to allow participants to indicate how useful the site was (where 0 = of no use, 50 = of some use, and 100 = extremely useful). For each main criterion, open-ended questions were also included when the site was rated below 50 points.

Table 9.1 The structure of the questionnaire and the purposes of its questions

	Categories	Purpose of questions	Sources
Part A	Overall opinions	• Collection of overall opinion and additional suggestions. *Sub criteria: first impression, strengths, weaknesses and additional features.* • Evaluation of the clarity and useful value of the prototype. *Sub criteria: clarity of the website's purpose, useful menu and types of support.*	Abels *et al.* (1998); Cato (2001); Elling *et al.* (2012);
Part B	Website's content, ease of use and appearance	• Evaluation of the acceptance of the website's contents. *Sub criteria: usefulness, depth & scope, interest and reliability.* • Evaluation of the acceptance of the website's ease of use.	

		Sub criteria: design, navigation, layout, colour, image and font.	
Part C	Comparison	• Evaluation of the useful value of the prototype	

The next step was to prepare a web-based tutorial that helps remote participants to understand and search for information effectively (Foust, 1999). The tutorial explained how and why the prototype was created and how to use it. This tutorial required access to the internet and was 14 pages in length. Each page was coded using Flash (PC version) and HTML (Mac version), and the tutorial allowed participants to either move to the next page or go back to the previous page. Figure 9.2 shows one example page of the tutorial.
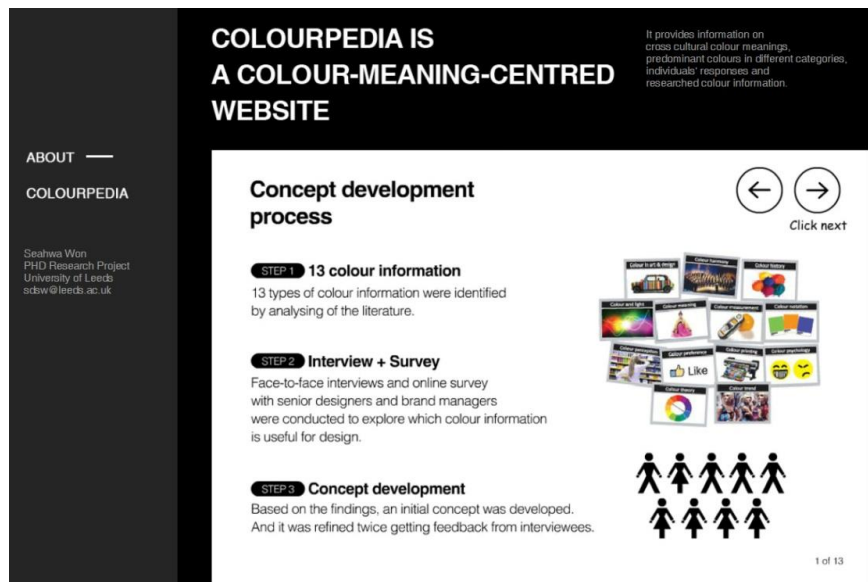
Figure 9.2 Web-based tutorial for the expert evaluation survey

(http://www.colourpedia.org/expert.html)

9.3.2 Recruitment of participants

In order to recruit experts from the colour, packaging, and branding fields, purposive sampling was carried out. Recruiting e-mails and LinkedIn messages were sent to the potential participants. In order to ensure the selection of experts, the potential experts' work experience or the relevance of publications were considered during the recruiting process (Rubio *et al.*, 2003). Initially, two designers and a marketer working for Pantone

(a world leading American colour company) were contacted using messages on LinkedIn. This act produced two responses. Subsequently, 17 UK universities were identified by searching the internet and including subject areas on graphic and branding. Using e-mail addresses on the university websites, 50 academics from the University of Leeds, Brunel, Edinburgh, Lancaster, Loughborough, Manchester Metropolitan, Nottingham, Reading, Brighton, Coventry, Dundee, Lincoln, Arts London, Norwich, Huddersfield, Southampton, and Queen Mary were contacted. Moreover, two lecturers and one professor each from the University of Sook-Myung (Korea), Kyung-Hee (Korea), and Fu-Jen (Taiwan) were contacted. These evoked seven responses. Rubio *et al.* (2003) suggested that 6-20 participants are an adequate number of experts. In total, eight experts were recruited for this research, as shown in Table 9.2. A majority of the responded experts had related experience in colour, graphic design, and branding.

Table 9.2 Participant attributes

Interviewee ID	Specialised area	Participant position
K	Colour	Senior manager in Pantone
L	Colour	Lecturer in Leeds University
M	Branding	Lecturer in Leeds University
N	Branding	Lecturer in Southampton University
O	Branding	Lecturer in Queen Mary University
P	Graphic design	Lecturer in Fu-Jen University
Q	Graphic design	Professor in Sook-Myung University
R	Graphic design	Lecturer in Kyung-Hee University

9.3.3 Survey process

In order to maximise the response rate and encourage participation, a number of strategies were adopted. The potential participants received e-mails or LinkedIn messages, including the invitation for participation and an introduction with the background information of the researcher. The letter included a title and details about the study, the reason why the participants were contacted, what questions they would be asked to answer, and information about data confidentiality (Appendix F2). In order to encourage more participants, a web-based recruitment page was created, and the link

was provided in both the invitation e-mail and a LinkedIn message. When the link was clicked, the recruitment web page showed a short Flash video (1 minute) with the detailed information of the survey. Figure 9.3 shows the web-based recruitment page.
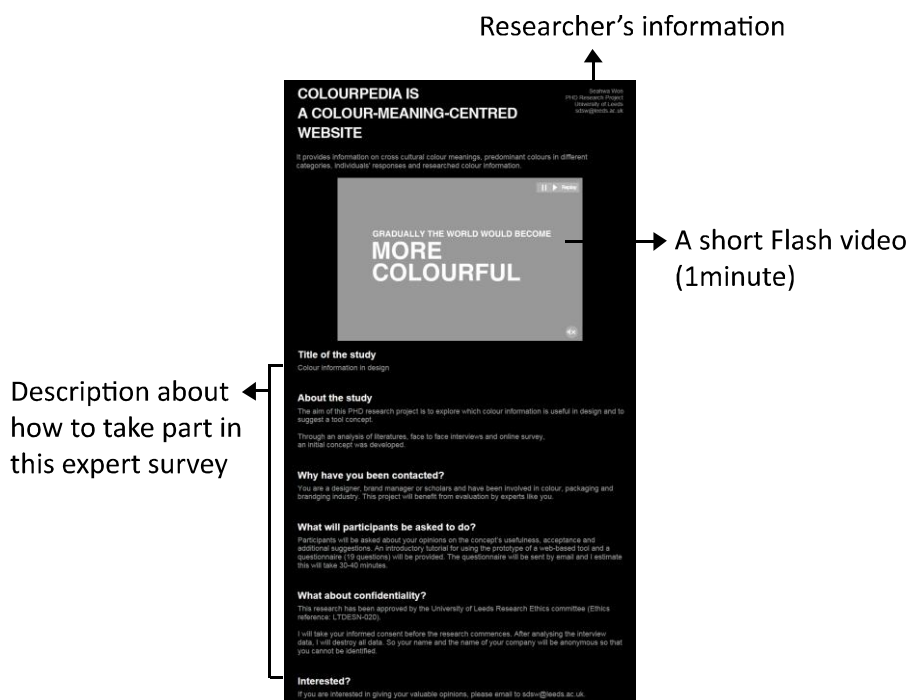

Figure 9.3 Web-based recruitment page

(http://www.colourpedia.org/recruiting.html)

The eight participants who responded to the recruitment message received all survey materials together in one e-mail including instructions (Appendix F3), an information sheet (Appendix F4), an informed consent form (Appendix F5), a questionnaire, and a web-based tutorial. The e-mail instructions explained how to execute the survey links, what forms to fill out, and where to return them by mail. The survey consent form could have been returned in various ways, such as returning a signed form via fax or e-mail, or stating via e-mail that the consent form had been read and agreed to (Meho, 2006). In this expert evaluation survey, the consent form was sent to participants with a statement like, 'If you send back this consent form by e-mail, it indicates you have agreed to all of the above criteria'. This procedure was chosen in order to protect their personal information and also to avoid the possibility of dropouts if the participants were unwilling to send their signature to people whom they did not know.

Reminders were sent to participants every two weeks. When the reminder e-mails were sent, all important files were enclosed once more (e.g. the information sheet, informed consent form, and questionnaire) because some participants may have had difficulty locating the previously sent e-mail.

9.3.4 Data analysis method

Data from the expert evaluation surveys was analysed using conventional descriptive statistics that indicated the frequency distribution of the data and also the mean of the values with various evaluation criteria. For the qualitative data, the open-ended comments were coded and clustered using a template approach (King, 2012).

9.4 Results

In total, eight experts evaluated the CMCW prototype. There were two primary goals of the expert evaluation survey. The first was to evaluate the prototype, and the second was to collect additional suggestions. The following five topics are displayed to address the survey objectives.

1. Overall opinions
2. Clarity of the prototype
3. Acceptance of the prototype
4. Useful value of the prototype
5. Additional suggestions

Tables 9.3 to 9.6 and Figures 9.4 to 9.9 summarise the key results regarding each topic. The results are displayed along with the frequency and mean score rated by participants in terms of each criterion of the survey. For the frequency of the comments mentioned by participants, the maximum number was eight because the total number of participants was eight. The most frequently mentioned comments were presented at the top of the list. No matter how many times a comment was mentioned by one participant, it was only recorded as being mentioned once.

9.4.1 Overall opinion

Three open-ended questions in the part A of the survey were concerned with what was the first impression and what were the strengths and weaknesses of the prototype. The answers stated by the participants were coded, and the various comments were displayed along with the frequency at which they were mentioned by participants, as shown in Table 9.3. The specific questions for part A were as follows:

- What are your first impressions about the concept of the website?
- What are the strengths of the CMCW?
- What are the weaknesses of the CMCW?

Overall, the prototype was perceived to be new and interesting, and the strengths of the prototype were also mentioned as strong potential and accessible interface. However, a wide range of comments was included regarding the weaknesses of the prototype.

Table 9.3 First impression, strengths, and weaknesses of the prototype

Overall opinion	Frequency
First impression	
New and interesting	6
Comprehensive and exhaustive	1
Strengths	
Strong concept and great potential	4
Clear layout, simple navigation, font size, font style	3
Offers useful information and supports good decisions	3
Well-structured framework and accessible interface	2
Two-way communication and participation	1
Provides colour insights	1
Weaknesses	
Lack of or too much colour information	4
Limited sample pages	1
The choice of crisp packages as the primary example	1
Accuracy and legal issues of Pantone code	1
Cross media colour representation	1
Lack of clarity between user generated data and colour expertise data	1

9.4.2 Clarity of the prototype

One question in part A of the survey was concerned with whether the concept of the prototype was clear to the participants. It aimed to address the clarity of the prototype. Participants were provided a polar question of 'yes' or 'no'. The total number of the participants was eight. Thus, the maximum number of frequency was eight. An open-ended question was included to explain the reasons when participants chose 'no' for the question. The specific question for part A was as follows:

- Is the concept of the CMCW is clear to you?

Figure 9.4 presents the result of the frequency addressed by participants on the clarity of the prototype. Seven out of eight participants responded 'yes' to this question, while the frequency of 'no' responses was very low. This result suggests that the developed prototype and the tutorial helped participants' easily understand and support good information for the prototype evaluation. The open-ended comment section contained space for explanations for the reasons why participants stated 'no' for the clarity of the prototype. The one participant who responded in this manner revealed that he thought the number of sample pages were not sufficient to evaluate.
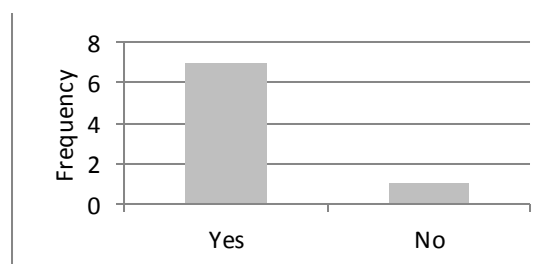
Figure 9.4 Clarity of the prototype

9.4.3 Acceptance of the prototype

Part B of the survey was concerned with whether the website's content, ease of use, and appearance were acceptable. In order to assess the acceptance of the prototype,

participants were asked 10 questions. The criteria for the quality of the website's content were concerned with its usefulness, depth and scope, interest, and reliability. The criteria for the ease of use and appearance dealt with the overall design, navigation, layout, colour, images, and fonts. Participants rated these aspects using a slider bar indicating the value from 0-100 (where 0 = of no value, 50 = acceptable, and 100 = exemplary). The specific questions for Part B were as follows:

- Is the website's content useful for the packaging and branding industries?
- Is the depth and scope of the website's content appropriate?
- Does the website's content enhance visitors' interest?
- Is the website's content reliable?

Figure 9.5 presents the mean score rated by participants on the website's content and appearance. For the two questions on whether the website's content was useful for the packaging and branding industries and whether the website's content enhances visitors' interest, participants gave favourable response ratings of 79.29 and 70, respectively. However, on another two questions regarding whether the depth and scope of the website's content were appropriate and whether the website's content was reliable, participants gave low response ratings of less than 70 (mean score). One participant out of eight dropped out of these four sub categories (usefulness, depth and scope, interest, and reliability) of the survey, and another participant dropped out of one sub category (reliability). The open-ended questions provided the reasons for the low marks and no answers and are shown in Table 9.4.
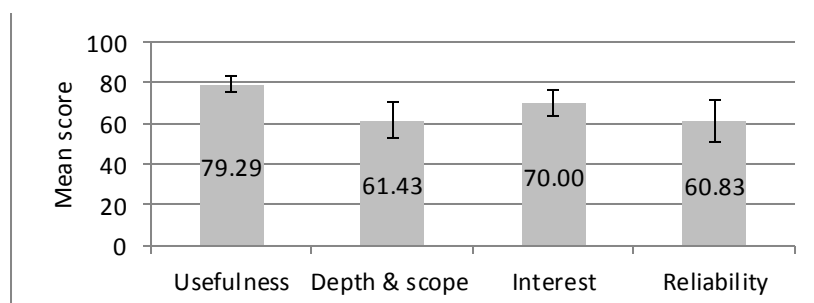
Figure 9.5 Quality of the website's content and appearance

Table 9.4 presents open-ended comments for the question of why participants rated any of the questions (among the criteria of usefulness, depth and scope, interest and reliability) below 50 points. For the depth and scope of the website' content, two participants raised two different issues: the lack of sample pages and an inability to help readers understand colour using simple words. In regards to the reliability of the website's content, two participants stated that it was not clear where the information came from, and there was no way to verify the information. This could be due to the fact that the prototype was not a fully functioning website and only contained 10 sample pages.

Table 9.4 Participants' comments

Participants' comments	Frequency
Depth and scope	
Lack of sample pages	1
Difficult to understand various colour phenomenon with simple words	1
Reliability	
Lack of explanation about where the information is taken from	1
No way of verifying the reliability of the information	1

Figure 9.6 presents the mean score rated by participants on the ease of use and appearance of the website. The specific questions for part B were as follows:

- Is the site's design aesthetically appealing?
- Are the links for navigation clearly labelled to allow the reader to easily move
   from a page to related pages and not become lost?
- Is information arranged for clear and easy understanding?
- Do the colours of the background, fonts, unvisited and visited links, and forms detract
   from the content, and are they consistent across pages?
- Do the graphic images enhance the information?
- Are the fonts appropriate to read?

Overall, the participants gave encouraging responses and rated most of criteria greater than 70. However, for the question of whether the information had been arranged for

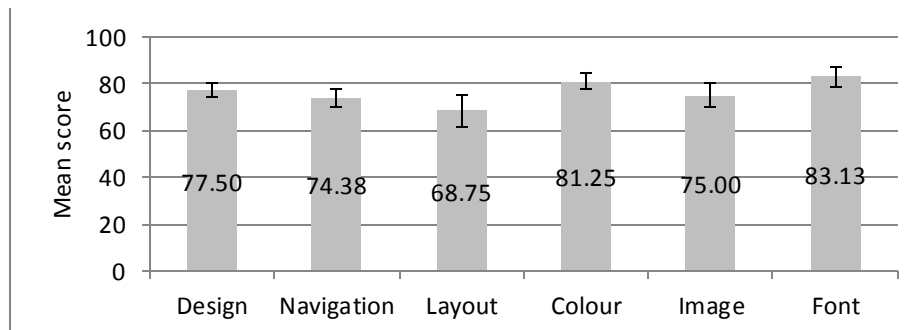clear and easy understanding, participants gave an average score that was slightly less than 70.

Figure 9.6 Ease of use and appearance

9.4.4 Useful value of the prototype

Three questions in parts A and C of the survey addressed the useful value of the prototype. The two questions in part A were multiple choice questions, and the one question in part C was a rating question. The specific questions for parts A and C were as follows:

- What types of support do you think the CMCW could provide to professional users?
- Which six menus would be most useful for professional users?
- For each of the websites, please score how useful they are for packaging and branding.

Figure 9.7 presents the frequency addressed by participants in regards to the question of what types of support the participants think the CMCW could provide to professional users, such as designers, brand managers, brand or market researchers, etc. The question included an open-ended question under the 'others (please specify)' option. Five out of eight participants answered this question with similar responses that the CMCW would be useful for 'insight', 'colour decision', 'creativity and inspiration', and 'colour strategy'. The result also indicated that the CMCW would help participants 'save time and effort', which was selected by four participants.

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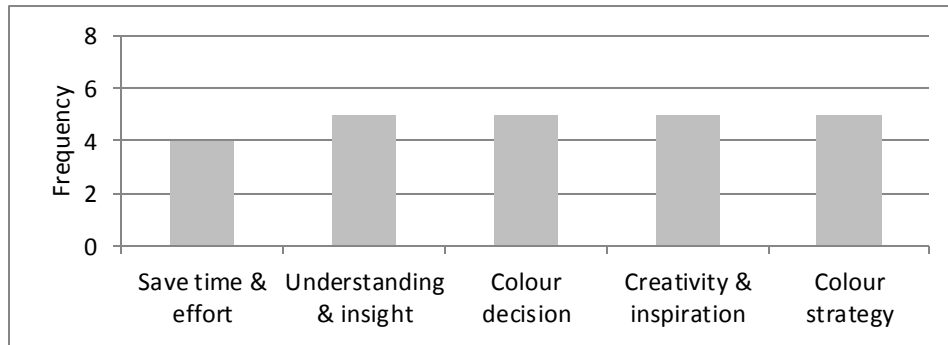
Figure 9.7 Types of support

Figure 9.8 presents the frequency with which participants addressed the question of the most useful menus among the six menus of the prototype. Participants were provided a multiple-choice question with a picture that indicated the six menus including Packaging, Logo, Meaning, Our research, Discussions, and E-learning. An open-ended question was provided to explain their choice. The Packaging and Logo menus had the highest frequency among six participants, while the E-learning menu showed the lowest response by being chosen only by two participants.
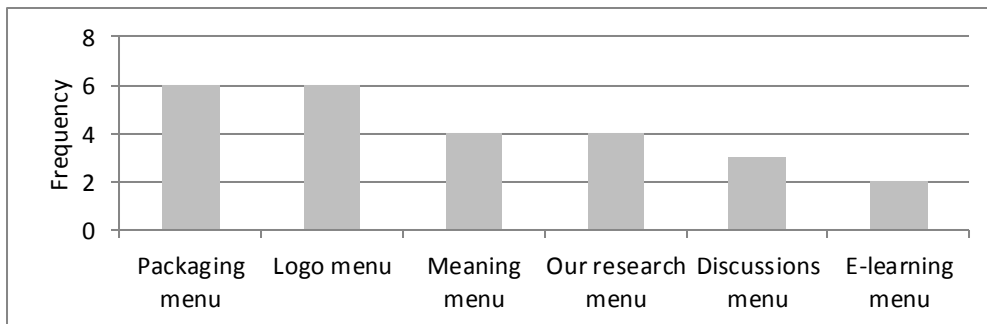
Figure 9.8 Most useful menu

Table 9.5 presents the open-ended comments regarding why a specific site menu among the six was considered to be useful to the professional users. A wide range of reasons were mentioned to explain their choices. Overall, the six menus were perceived to be insightful and could be applied to the design, strategy, and execution stages.

Table 9.5 Participants' comments on their choices of the six menus

Participants' comments	Frequency
Packaging menu	
Insightful	2
Applicable for design and strategy	1
Logo menu	
Insightful	2
Applicable for design and strategy	1
Meaning menu	
Insightful	1
Applicable for design and strategy	1
Fresh information	1
Our research menu	
Insightful	1
Applicable for design and strategy	1
Discussions menu	
Sharable	1
Applicable for design and strategy	1
E-learning menu	
Applicable for design and strategy	1

Lastly, for the value of the prototype, part C of the survey provided four colour websites, including three existing colour websites and the CMCW, with relevant links to open them. For the CMCW prototype, a description such as 'please use the concept to evaluate the CMCW as you think it would be if it were live and functioning' was included because it was still a non-functioning concept at the time of the testing, while the three existing websites were fully operational. The existing colour websites were chosen based upon the amount of website traffic searched by a web traffic counting site (Alexa.com). The selected colour websites were Kuler, Pantone, and Colour Lover. Participants rated the sites using a slider bar to indicate the value from 0-100 (where 0 = of no use, 50 = of some use, and 100 = extremely useful). One participant out of eight dropped out of this category of the survey. Figure 9.9 shows the mean score rated by the participants. The participants gave an encouraging response, rating the CMCW with the highest score of 72.86.
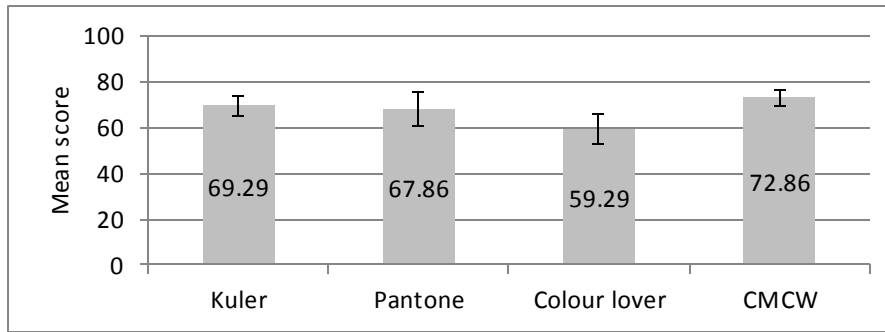
Figure 9.9 Three existing colour websites and CMCW

9.4.5 Additional suggestions

One open-ended question in part A of the survey was concerned with what additional features the participants would have liked to see on the CMCW. The answers given by the participants were coded and displayed according to the frequency at which they were mentioned by participants, as shown in Table 9.6. For the website' content, a comment made by participants suggested that the prototype should include an overview page that explained the purpose of the site. Another comment suggested that the prototype should present more detailed demographic responses. The relevant participant's quote was as follows: "I like the concept, and believe it has great potential. I think more detail about the demographic responses to colour could be interesting. Ultimately, those responsible for any aspect of the commercial realisation of colour want to know that their choices will be relevant within their target markets" (a senior manager at Pantone).

Apart from that, most of the suggestions were applicable for further development. However, some recommendations, such as colour history and colour application in product design, were ambiguous and much too broad.

Table 9.6 Additional suggestions stated by the participants

Additional suggestions	Frequency
Website's content	
Overview pages on the purpose and the background of the site	3
More details about the demographic responses	1
A more detailed explanation for each main menu	1

Consideration of the commercial realities	1
Colour history	1
Colour application in product design	1
Colour forecast	1
Ease of use and Appearance	
A logo design for the site	1
Others	
E-book and mobile app design	1

9.5 Discussion

In this section, the main objectives of the survey are reviewed. After that, the limitations of the methods adopted for the studies in this chapter are discussed.

9.5.1 Reflection on objectives

Overall, the prototype was evaluated positively based on its usefulness, strong potential, novelty, and well-structured appearance. However, some negative comments were also collected, such as the lack of sample pages or information that detailed where the data had been drawn from. The results of the expert evaluation survey and additional suggestions that were collected are as follows.

Clarity of the prototype. Seven of the participants (N=8) believed that the purpose of the prototype was conveyed clearly to them. This means that the web-based tutorial and the HTML prototype used for the survey were clear enough to communicate with participants.

Acceptance of the prototype. Four sub criteria (usefulness, depth and scope, interest, and reliability) for the website's content and six sub criteria (design, navigation, layout, colour, image, and font) for ease of use and appearance were judged by the experts. The participants were asked whether the 10 criteria for the prototype were acceptable. This aspect was tested because 'acceptance' ultimately affects whether or not the product is used (Lewis, 2006). The website's content was perceived as useful and interest-enhancing and was rated as greater than 70 (mean score) by participants, whereas the

depth and scope and reliability were rated less than 70. It was assumed that the low scores were due to the lack of sample pages.

Useful value of the prototype. To assess the useful value of the prototype, the participants were asked three questions. One question was what types of aids the CMCW could provide to professional users. It was perceived that the prototype was useful for enhancing insight, colour decision, creativity, and colour strategy, as these attributes were evenly selected by five participants. More specifically, another question asked the participants which of the six menus would be most useful for professional users. 'Packaging' and 'logo' menus received the highest responses and were selected by six participants. Lastly, participants were provided three existing colour websites and the CMCW and asked to rate scores in regards to how useful each one was for the packaging and branding industries. Encouragingly, the CMCW received the highest score which was greater than 70. Therefore, the prototype has great potential; when it is realised, it could provide useful colour information to professional users.

Additional suggestions. A wide range of varied suggestions for the prototype was collected. Most of the suggestions, such as creating an overview page, including more demographic responses, providing a detailed explanation for each menu, and designing a logo, were applicable for further development. However, some suggestions, including colour history, colour application in product design, and e-book and app design, were too vague and will therefore need further clarification.

9.5.2 Critique of the research methods

An e-mail survey was employed as the most appropriate data collection method for this study. The main challenge for the method was to recruit participants. It was possible that potential participants could simply ignore the invitation e-mails or messages. To increase the response rates, reminders were sent to all potential participants, and a web-based invitation page that included a Flash video was produced to enhance their interest. Moreover, in order to minimise the miscommunication derived from the absence of a researcher, a web-based tutorial was also produced.

9.6 Conclusions

This study showed that the developed prototype was useful and appropriate for professional users in packaging and branding. The outcome also highlighted the dominant role of the CMCW that would support colour insights, colour decisions, colour strategy, and inspiration. The experts perceived and evaluated the CMCW as a more effective and useful tool compared to existing colour websites. Although experts' opinions on suggestions for the prototype were varied, and it was difficult to achieve a consensus in terms of the survey criteria, such as depth and scope and reliability, the site was perceived to have great potential and be useful overall.

Chapter 10
CONCLUSIONS

"Colour defines our world and our emotions"

(Feisner, 2006, p.2)

This chapter presents a summary of the study and the overall conclusions of this research project based on the main findings. Furthermore, the implications from a theoretical, methodological, and practical perspective are also discussed. Finally, the limitations of the study and recommendations for future work are outlined.

10.1 Summary of the thesis

This research set out to investigate which colour information is useful in packaging and and to suggest a tool (as a concept at least) to deliver the useful colour information to design professionals. As described in Table 10.1, these aims were realised by conducting the research activities to meet the research objectives. Colour information in design is still an underexplored area; therefore, this study carried out exploratory research to identify important features of colour information itself and a suitable colour tool format within packaging and branding to deliver the desired information to users. The key finding of the study was that current colour information is not effectively utilised by design professionals. In other words, it was found that harmony, perception, meaning, psychology, and printing are important types of colour information to designers and brand managers for packaging and branding. However, they did not tend to formally use any information except with regard to printing. Therefore, there is a gap between what users use and what users need. Based on the understanding of the characteristics for the useful colour information, it was recognised and assumed that colour-meaning-centred information would be needed and helpful for professional users, and a web-based tool prototype was created, refined, and tested. This study presented evidence for the potential and strong demand for resources and tools on colour meaning that could support design professionals.

Table 10.1 Meeting the research objectives

Research objectives	
1. To review relevant literature and secondary sources in regards to the following:	Chapter 2
- The contexts of a colour information study in design	
- The definition and types of colour information in the literature	
- The existing colour information tools	
- The key roles of colour in packaging and branding	
- The characteristics of design information	
- The advantages of using colour information in design process and strategy	
2. To investigate the types of and the reasons for useful colour information in packaging	Chapter 4
3. To explore what type of colour information is used by designers and brand managers	
4. To probe designers' and brand managers' preferences and suggestions for a colour tool	
5. To explore whether colour meanings are affected by context	Chapter 5
6. To investigate what colour meanings are communicated in a product category	Chapters 6 and 7
7. To develop a concept of a colour tool	Chapters 8 and 9

Chapter 2 provided an understanding of the concepts and the types of colour information by reviewing the relevant literature. Due to the novelty of colour information study in the design field, a review of the state of current colour knowledge across many different fields was necessary to explore what types of colour information exist. Using this method, 13 types of colour information were identified: colour in art and design, harmony, history, light, meaning, measurement, notation, perception, preference, printing, psychology, theory, and trend. Further, a brief analysis of an existing colour information tool was given that was related with the 13 types of colour information as well as the main features of the tools. Focusing on the design areas, such as packaging, the importance of colour and the advantages of using colour information to support design professionals in design process and colour strategy were discussed.

The literature review concluded by emphasising the need for colour information study in design.

Chapter 3 presented the overall methodological approach employed in the study. A constructivist paradigm was adopted, and a specific iterative methodology was designed to carry out this study. Interviews, an online survey, a colour meaning experiment, a colour meaning framework, a colour meaning case study, a prototype development, and an expert evaluation survey were planned, and the methods used for the data analysis were explained.

Chapter 4 explored which colour information was useful, why that particular type of colour information was useful, what colour information were used by professional users, and the experts' preferences and suggestions for a colour tool. These were achieved through face-to-face interviews and an online survey using the 13 types of colour information derived from the literature review. The key findings from the interview and online survey were as follows:

- Colour decisions by designers and brand managers are predominantly made though understanding a brand, market, and audience.
- Colour information for professional users in packaging and branding should devote special attention to harmony, perception, meaning, psychology, and printing. In addition, there was no significant difference in the types of colour information considered to be important by designers, brand managers, and researchers.
- Five specific types of colour information were considered to be important; harmony (related to intuition), perception (intended to attract consumers' attention), meaning (used to convey a message), psychology (employed to create consumers' responses) and printing (direct at the desired end result). This suggests that designers and brand managers need both practice-related (tacit knowledge) and systematic information (explicit knowledge) in their design process and strategy.

- Current colour information is not effectively used by design professionals. More specifically, there is only minimal use of colour information, and a gap exists between what they use and what they need. Current use of colour information has been very limited, mostly relying on the use of Pantone chips. The information was mostly located through self-searching or by contacting the clients directly. In terms of design professionals' satisfaction of colour information, it was perceived as not being aware of. The need of colour information was for the strong back up for colour choice, their ability to make quick, easy, and informed decisions, break a category norm or begin a new trial, and better understand colour.

- The most preferred colour tool format was a website because professional users preferred to be able to work on a desktop. The preferred data presentation type was a colour palette.

- There exists much demand to be recognised as a colour tool, such as colour meaning and predominant colour by product categories, colour insight or learning, colour combinations, CMYK, RGB, NCS, and Pantone code, which colour attract attention, colour trend, individuals' response, researched, device to match colour from design to print or identify colour on the product, regularly updated, community site, colour psychology, and inspiring website.

In Chapter 5, a colour meaning experiment was conducted. Before moving on to colour tool development, it was recognised as imperative to explore the relationship between colour meaning and context. The key findings from this experiment were as follows:

- In about one third of cases (28%), there were significant differences between chip meaning and context meaning. In nearly three quarters of cases there were no such significant differences.

- The colours red and black, the product types for hand washing soap and medicine, and the bi-polar words for masculine-feminine and elegant-vulgar were context dependent. On the other hand, the colours beige, blue, green, and yellow; the product types for cosmetics, crisps, toilet tissue, and white wine; and

bi-polar words for warm-cold, modern-traditional, and expensive-inexpensive were context independent.

- Colour meaning information derived from past studies but which did not take into account the specific context can be used for the initial colour decision. However, during the colour design process, the initial colour decisions should be reconsidered by scrutinising the particular contextual characteristics.

- In colour tool development, colour chips should be organised by different product categories since some colour meanings are affected by context.

- However, it should be questioned whether it is appropriate to choose a colour meaning based on existing colour books or websites because it is not clear where the data came from.

Chapter 6 established a colour meaning framework in order to provide an understanding of what types of colour meanings are communicated in a product category. Practice (existing colour strategies) and semiotic theories were integrated.

Chapter 7 carried out a colour meaning case study in order to gain in-depth insight on colour meaning in a product category. Based on a suggestion from the brand manager who worked for one leading UK consumer goods manufacturer, one particular product category—a washing-up liquid product—was focused. Market research for the washing-up liquid was conducted by applying the framework developed in Chapter 6 and was based on consumer studies on colour. In order to explore which green colours best describe expensive-inexpensive, effective-ineffective, safe-unsafe and environmentally friendly-non environmentally friendly, a colour meaning experiment was conducted. Lastly, the developed colours were discussed with a brand manager to explore the usefulness of colour meaning information in their packaging development process. The key findings from the case study were as follows:

- In terms of colour use for current UK washing-up liquid products, a generic colour code exists. For instance, deep green is often used for the original version. Yellow indicates a lemon flavour, while green stands for an apple flavour, and so

on.

- When consumers purchase a washing-up liquid, price (60.1%) and smell (47%) are the most important factors, and efficacy (38.9%), colour (34.2%), and brand (30.3%) are next important. Safety (24.9%), the size of the packaging (11.1%), and the shape of the packaging (9.1%) are less important. The additional factor of environment (10.8%) emerged from this online survey.
- The results of the colour meaning experiment presented that yellowish and bluish green colours in washing-up liquid packaging infer positive meanings such as safe, eco-friendly, effective and expensive whereas saturated and dark green colours represent negative meanings such as unsafe, non-eco-friendly, ineffective and inexpensive.
- The interview with a brand manager solidified the usefulness of this kind of colour meaning information in their design process and strategy.

Chapter 8 enacted a design task to develop a prototype of a colour tool. A more detailed understanding of a colour tool was gained. The key insights were as follows:

- Delivering useful colour information: The developed prototype clearly demonstrated a need for colour-meaning-centred information as appropriate information.
- Website content: Design professionals seek colour information in formal, informal, and sharable senses. When they used the tool as a database, they could obtain researched and explicit information relevant to their current project. At the same time, users can share interesting ideas and look for colours across categories.
- Suitable access: A web-based tool presented in a highly visual, interactive, and easy manner is appropriate as it is relevant to the design professionals' way of working.

Chapter 9 evaluated the final prototype with experts in an attempt to investigate the acceptance and usefulness of the prototype. These studies provided evidence that the

CMCW could increase work efficiency and was effective by providing useful colour information to users. The key results were as follows:

- The CMCW can be a useful tool for design professionals in support of colour insight, decision, inspiration, and strategies.
- The CMCW has an adequate format for valuable use in terms of the site's content and ease of use.
- The CMCW (mean useful score provided by experts = 72.86) was the most useful website compared to the current colour websites, such as Kuler (69.29), Pantone (67.86), and Colour Lovers (59.29).

10.2 Research contributions

This research contributes to the fields of design research and design practice. Primary and secondary contributions of the research are outlined in the following subsections.

10.2.1 Primary contributions

First, the novelty of this research makes a significant contribution to the existing design literature. For the first time, this study addressed what useful colour information in design was. Despite the importance of colour in design, there is little (if any) understanding of colour as a type of information. A lack of understanding of colour information in design could generate theories and prompt research into disjoined design. Therefore, it was concluded that colour information was an unexplored area, and the need for a better grasp of colour information by design professionals was highlighted. As a result, this research provided an understanding of colour as information and outlined a holistic overview of 13 types of colour information in the literature, clarifying overlapping concepts (Section 2.3). Also, the research detailed the specific characteristics of useful colour information through complementary studies. Thus, this research addressed the scarcity of knowledge in this area.

Second, the findings of the study provide insight into the usefulness of colour-meaning-

centred information for design professionals in the design process and strategy. Available colour knowledge in the existing literature tends to be comprehensive across various fields, such as science, design, education, history, etc. Due to the breadth and the multiple nature of colour, it is not clear whether colour information has been effectively utilised in design. The findings of this study presented the relative importance of five types of colour information (harmony, perception, meaning, psychology, and printing). This research examined the usefulness of colour meaning information, and a more-detailed understanding of colour information in design was gained. The insight from this work will help researchers, design professionals, and colour-tool developers to make informed decisions on what they should focus on, how they should do so, and why. This will facilitate better provisions and uptake of useful colour information for design professionals in the design process and strategy fields.

Third, a colour meaning framework (Chapter 6) was established integrating existing colour strategies and semiotic theories. According to the framework, there are four characteristics of colour in a product category: the original substance colour, the arbitrary colour, the generic colour code, and differentiated colour. The contribution of the framework supports understanding of colour design practice in an analytic way, which was applied and tested by carrying out a product-specific case study (Chapter 7). No such framework existed prior to this research. Thus, the developed framework could help design professionals to understand the use of colour so that they may deal with colour tasks more effectively and efficiently. Additionally, the framework also could be employed in various design or marketing related research as a research tool to investigate and analyse colour.

Fourth, as practitioner, the researcher undertook a design project to develop a prototype of a colour tool based on the professional designers' and brand managers' suggestions (Chapter 8). The key features that the developed web colour tool can provide are as follows: colour meaning and predominant colours in different categories; researched information and shared opinions; individuals' responses on the current packaging and logo colours; and visual, interactive, easy, and up-to-date colour information.

10.2.2 Secondary contributions

The research contributes to the existing knowledge by conducting a design-focused colour experiment. Because current colour knowledge derives from various disciplines, little research has concentrated on design-focused-laboratory colour experiments, and most studies relating to colour meaning are conducted without a product context. Thus, the context of the research was established in packaging and branding, and it examined the relationship between colour meaning and context within brand packaging design (Chapter 5). Various types of product contexts, such as cosmetics, hand wash, crisps, toilet tissue, medicine, and white wine, were used in this study. A laboratory-based experiment was carried out to differentiate between colour chips, simplified object images, and real packaging. A new set of laboratory-based data for colour meaning within brand packaging design was generated, and the evidence presented to support the use of colour chips without a context can be possible in generating meaningful research. It is needed to be recognised that further experiments (with additional colours and other contexts) are needed to more robustly understand the relationship between chip meaning and context meaning. Nevertheless, this work demonstrates a methodological approach that could be adopted by other researchers. This process, therefore, offers a good point of reference to other researchers, who may wish to further explore the relationship between colour meaning and context.

10.3 Research limitations

Multiple studies were carried out in this PhD research, and each study had its own limitations. Some of the limitations have already been discussed under the 'Critique of research methods' section in the relevant chapters (Sections 4.7.6, 5.5.2, 7.5.2, 8.6.2, and 9.5.2). Revisiting the constraints of this research, the overall limitations of the study are outlined as follows:

First, as the current study employed both the exploratory and constructivist approach, there are some limitations inherent to the research methods. Subjective opinions for useful colour information were collected from designers and brand managers based

upon their actual needs and assumed needs, and a practice-based design project to develop a colour tool concept was undertaken. Thus, no definitive evidence of useful colour information in design can be drawn.

Second, the findings might lack generalisability to different design fields, different design firms, or different nations. This study collected data with 10 senior designers and brand managers in a specific context of packaging and branding in London (UK). The characteristics of the participants were robust and varied. Some of them worked for global brands, while others were employed by smaller businesses. The average amount of time participants had spent working in their lives was mostly more than 10 years. Moreover, the online survey supplemented the interviews; thus, the external validity of the findings increased. However, although designers and brand managers provided particular types of information, it does not mean that such information can cover all various design fields, such as fashion, electronics, etc., and design firms in different countries. Due to the limited amount of time available for the research, it was impossible to collect huge datasets from different countries and different age groups of design professional.

Third, the two separate colour meaning experiments in Chapters 5 and 7 were carried out in order to investigate whether colour meanings are affected by context and what colour meanings are communicated in a product category. This was not intended to generalise the findings and quantify large amounts of data; rather, it aimed to provide an understanding of colour meaning in a design context to inform the insight to a tool development phrase. Considering the result as a corner stone, more generalisable and ample data could be collected in further studies.

Fourth, the design outcome of a tool prototype was concerned with the possible feasibility to develop a useful colour tool for design professionals. Because of the time constraints for both the thesis and the initial aim of the research, the technical feasibility by programming the CMCW website was not considered.

10.4 Recommendations for further research

As the study had a strong, exploratory nature, the research presented herein should be considered as a starting point for future research. Directions and recommendations for future research are outlined as follows:

First, the outcome of the developed CMCW was a non-functioning prototype that included various ranges of colour information, such as predominant packaging colours, logo colours, colour meanings in different product categories, etc. A future study could be conducted that focuses on one specific type of colour information (e.g. the colour meanings in different product categories). Thus, data collection can be manageable in a short period of time and develop an actual functioning tool with the help of a professional programmer. It would greatly contribute to both this field of enquiry and to design practice if researched and tangible design-focused colour information were offered.

Second, this study proved that some colour meanings are affected by context. In order to provide more strategic colour information, it is important to investigate various target audiences in different cultures and of different ages, genders, etc. Thus, a future research study may be conducted to assemble both the differences and similarities of colour meaning and context from different target groups all over the world. This method would greatly contribute to the design strategy.

Third, this research had a western focus on studying useful colour information. For the interviews and online survey, the colour meaning experiment, the case study, and the expert evaluation survey, the participants were largely UK-based (all 10 interviewees, 32 out of 62 online survey participants, 25 students at Leeds University for the colour meaning experiment, 1 UK company, and 109 students and school staffs from Leeds University for the case study, and 3 UK-based and 1 USA-based expert from the 8 experts). Other future research can investigate design professionals in other countries where people have different perceptions, cultures, and characteristics in an attempt to adopt the same interview protocol from this PhD work.

Fourth, this study revealed that colour harmony, perception, meaning, psychology, and printing are of noticeable importance to design professionals in packaging and branding. Future research will be required to explore how design students are educated concerning the 13 types of colour information. If there is a gap between the important aspect of colour information and current design education, it would be worth exploring how best to bridge this gap.

Fifth, this study focused on colour information for professionals, such as designers and brand managers. In future studies, consumers' perspectives can be included so that the three perspectives of designers, brand managers, and consumers can be compared. This comparison may improve the understanding in regards to which types of colour information could be more strategically used after considering consumers' perspective.

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APPENDICES

Appendix A1: A list of 229 journals in Colour Research and Application

1	A consultation and simulation system for product color planning based on interactive genetic algorithms
2	The versatility of color in contemporary architecture
3	A digital imaging method for measuring banana ripeness
4	Color thresholds for aesthetically compatible replacement of stones on monuments
5	A note about the abnormal hue angle change in CIELAB space
6	Color measurement of a ruby
7	The Structure and Properties of Color Spaces and the Representation of Color Images.
8	Smoothing spectral power distribution of daylights
9	Choice-based experiments in multiple dimensions
10	The men who coloured Britain
11	Color and architecture in 1970s Sweden
12	Three color strategies in architectural composition
13	Geodesic calculation of color difference formulas and comparison with the munsell color order system
14	Extending CIELAB: Vividness, Vab*, Depth, Dab*, and Clarity, Tab*
15	Color–concept associations: A cross-occupational and -cultural study and comparison
16	Standard color liquid crystal displays by a dimming technology
17	Analyses of color emotion for color pairs with independent component analysis and factor analysis
18	The effect of paper appearance on printed color of inkjet printer
19	Equivalent lightness of elderlies investigated by cataract experiencing goggles
20	Helical structure of complementary colors' relative spectral distribution function
21	Tristimulus colorimeter calibration matrix uncertainties
22	Evaluation of the effect of retinal localized chromatic adaptation intensity on desaturated achromatic reproductions derived by standard rendering methods
23	Computational production of colour harmony. Part 1: A prototype colour harmonization tool
24	Computational production of colour harmony. Part 2: Experimental evaluation of a tool for gui colour scheme creation
25	Identification of traditional Thai colours used for mural paintings and Khon masks
26	Effects of hue, saturation, and brightness on color preference in social networks: Gender-based color preference on the social networking site Twitter
27	Comparison of real colour gamuts using a new reflectance database
28	Correlation and modeling between color variation and quality of the surface between accelerated and natural tropical weathering in Acacia mangium, Cedrela odorata and Tectona grandis wood with two coating
29	Visualization of mathematical inconsistencies in CIECAM02
30	Influence of surface roughness on the diffuse to near-normal viewing reflectance factor of coatings and its consequences on color measurements
31	Reproducibility comparison among multiangle spectrophotometers
32	Software for simulating dichromatic perception of video streams
33	Deep-black-coloring effect of fabrics made of noncircular cross-section polyester filaments
34	Color change of white spot lesions after resin infiltration
35	Use of effect pigments for quality enhancement of offset printed specialty papers
36	Correction of single-beam sample absorption error in a hemispherical 45°/0° spectrophotometer measurement cavity

37	Spectral deconvolution applications for colorimetry
38	Color composition in postmodern western architecture
39	Color reproduction of authenticable luminescent backlit transmissive color images
40	Effect of chemico-mineralogical composition on color of natural and calcined kaolins
41	Can eyes smell? cross-modal correspondences between color hue-tone and fragrance family
42	A zonohedral approach to optimal colours
43	Individual differences in human colour vision as derived from stiles & Burch 10° colour matching functions
44	Dictionary-based estimation of spectra for wide-gamut color imaging
45	Optimization of the method for color measurement of printing on holographic paper
46	Chromaticity-matched but spectrally different light source effects on simple and complex color judgments
47	Analysis of relationships between mood and color for different musical preferences
48	White lighting
49	Chromatic losses in natural scenes with viewing distance
50	Unique hues and their stimuli—state of the art
51	Colour and tolerance of preferred skin colours on digital photographic images
52	Visual assessment of light source color quality
53	Correlations between color attributes and children's color preferences
54	Method of urban color plan based on spatial configuration
55	Preference for color-enhanced images assessed by color deficiencies
56	Semantic interpretation of color differences and color-rendering indices
57	Shadow series in the Munsell system
58	No measured effect of a familiar contextual object on color constancy
59	Unique hue data for colour appearance models. Part II: Chromatic adaptation transform
60	Use of basic color terms by red–green dichromats: 1. General description
61	Recovering neugebauer colorant reflectances and ink-spreading curves from printed color images
62	Use of basic color terms by red–green dichromats. II. models
63	Perceived sexual receptivity and fashionableness: Separate paths linking red and black to perceived attractiveness
64	Correcting veiling glare of refined CIECAM02 for mobile display
65	Investigating the use of an adjustment task to set preferred colour of ambient illumination
66	Perceptual uniformity in digital image representation and display
67	Chromatic adaptation by illuminant matrix products: An alternative to sharpened Von Kries primaries
68	Effect of xenon arc irradiation on optical whitened polyester woven fabrics
69	Experimental determination of laws of color harmony part 8: Harmony content versus relative surface coverage
70	Saturation-specific pattern of acquired colour vision deficiency in two clinical populations revealed by the method of triads
71	Material and diagnostic characterization of 17th century mural paintings by spectra-colorimetry and SEM-EDS: An insight look at José de Escovar workshop at the CONVENT of NaSra da Saudação (Southern Portugal)
72	Modeling lightness perception—Another point of view
73	Riemannian formulation and comparison of color difference formulas
74	Applications of vectorial color
75	Color discrimination capability under highly structured spectra
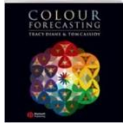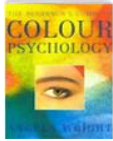
76	Lighting, indoor color, buying behavior and time spent in a store
77	On the relationship between wavelength and perceived hue
78	An open-source inversion algorithm for the Munsell renotation
79	Effects of correlated color temperature on spatial brightness perception
80	Experimental determination of laws of color harmony. Part 6: Numerical index system of color harmony
81	Testing uniform colour spaces and colour-difference formulae using printed samples
82	Evaluation of colour-difference formulae for different colour-difference magnitudes
83	The effects of achromatic and chromatic color schemes on participants' task performance in and appraisals of an office environment
84	Color assessment of granitic rocks and implications for their ornamental utilization
85	The affective feelings of colored typefaces
86	Anodic coloring of titanium and its alloy for jewels production
87	Behavior of a periodic chromatic test with an achromatic Ronchi grating as a background
88	A comparative analysis of the characteristics and images of costume colors in the traditional plays of Korea, China, and Japan
89	Ecommerce interface colour and consumer decision making: Two routes of influence
90	Mathematical approach for predicting non-negative tristimulus values using the CAT02 chromatic adaptation transform
91	Effect of chromatic components on facial skin whiteness
92	An investigation of colour appearance for unrelated colours under photopic and mesopic vision
93	Color tolerance prediction for recycled paper based on consumers' awareness
94	Variability estimation of hue and saturation components in the HSV space
95	Harmonious color model with fragrances
96	Color separation for colored fiber blends based on the fuzzy C-means cluster
97	The CRI-CAM02UCS colour rendering index
98	Goniochromatic properties of human tooth dentin
99	Making sense of measurement geometries for multi-angle spectrophotometers
100	The effect of nano- and micro-TiO2 particles on reflective behavior of printed cotton/nylon fabrics in vis/NIR regions
101	Request for existing experimental datasets on colour emotion and colour harmony
102	Practical method for measuring printed colors on FWA-treated paper
103	Colour scheme supporting technique based on hierarchical scene structure for exterior design of urban scenes in 3D
104	Age effects on colour emotion, preference, and harmony
105	Color composition features in modern architecture
106	A theory of unique hues and colour categories in the human colour vision
107	The Logvinenko object color atlas in practice
108	A new model for chromotherapy application
109	Print quality evaluation and applied colour management in coldset offset newspaper print
110	The influence of thermal treatment on color response of wood materials
111	An inverse to the Optical Society of America-Uniform Color System
112	A cross-cultural comparison of colour emotion for two-colour combinations
113	Colour size effect modelling
114	Color–emotion associations in the pharmaceutical industry: Understanding Universal and local themes

115	Optical implementation of spectral filtering for the enhancement of skin color discrimination
116	A Monte Carlo method for assessing color rendering quality with possible application to color rendering standards
117	Quantification of scene appearance—A valid design tool?
118	The effects of functional polysiloxane resins on the color gamut and color yield of dyed polyester
119	Color and women hitchhikers' attractiveness: Gentlemen drivers prefer red
120	Object color preferences
121	Applying image-based color palette for achieving high image quality of displays
122	On the colours dichromats see
123	Setting tolerances on color and texture for automotive coatings
124	An interactive method for generating harmonious color schemes
125	Exact location of consensus and consistency colors in the OSA-UCS for the italian language
126	Practical demonstration of the CIEDE2000 corrections to CIELAB using a small set of sample pairs
127	Dependence of the color appearance of some flowers on illumination
128	Grey and greyness—its complexities in color appearance of surface colors
129	Digital image-color conversion between different illuminants by color-constancy actuation in a color-vision model based on the OSA-UCS system
130	Experimental determination of laws of color harmony. Part 7: Experiments carried out with eyes adapted to light and dark
131	Measuring linear density of threads in single-system-mélange color fabrics with FCM algorithm
132	Geometric invariants under illuminant transformations
133	A study of color differences in women's ready-to-wear collections from world fashion cities: Intensive study of the Fall/Winter 2010 collections from New York, London, Milan, and Paris
134	Estimation of illuminant chromaticity based on highlight detection for face images with varying illumination
135	Different matrices for CIECAM02
136	Influence of different disinfecting solutions on the color change of artificial irises used in ocular prostheses
137	Comparative performance analysis of spectral estimation algorithms and computational optimization of a multispectral imaging system for print inspection
138	Preferred color gamut boundaries for wide-gamut and multiprimary displays
139	Human brain activity and emotional responses to plant color stimuli
140	The use of reflectance measurements in the determination of diffusion of reactive dyes into cellulosic fiber
141	Coffee cup color and evaluation of a beverage's "warmth quality"
142	Reflection measurement and visual evaluation of the luminosity of skin coated with powder foundation
143	Camouflage of cotton fabrics in visible and NIR region using three selected vat dyes
144	The effect of hue on the perception of blackness using munsell samples
145	Canonical biplot statistical analysis to detect the magnitude of the effects of phosphates crystallization aging on the color in siliceous conglomerates
146	Compression of spectral data using Box-Cox transformation
147	Does lightness obey a log or a power law? Or is that the right question?
148	Modeling lightness perception—A response to Kuehni
149	Complementary colors theory of color vision: Physiology, color mixture, color constancy and color perception
150	Color constancy, color-mixing ability, and color inference
151	Categorical formation of Mandarin color terms at different luminance levels
152	Paramerism and reliable parameric correction
153	Colour changes of heat-treated woods of red-bud maple, European hophornbeam and oak

154	Additivity of colour harmony
155	Skin-color correction method based on hue template mapping for wide color gamut liquid crystal display devices
156	Iris color and texture: A comparative analysis of real irises, ocular prostheses, and colored contact lenses
157	Applying metamer sets to investigate data dependency of principal component analysis method in recovery of spectral data
158	Designing white-light LED lighting for the display of art: A feasibility study
159	Unique hue data for colour appearance models. Part I: Loci of unique hues and hue uniformity
160	A revision of the luminance decay time estimation methods for photoluminescent products
161	Ordinal scale based description of colour rendering
162	Lighting the world's treasures: Approaches to safer museum lighting
163	Color classification using color vision models
164	Brighter, more colorful colors and darker, deeper colors based on a theme of brilliance
165	Near-lossless compression methods for spectral images
166	Using weighted pseudo-inverse method for reconstruction of reflectance spectra and analyzing the dataset in terms of normality
167	Evaluation of discomfort glare from color leds and its correlation with individual variations in brightness sensitivity
168	Investigation of colour size effect for colour appearance assessment
169	Colour psychology and colour therapy: Caveat emptor
170	Colour appearance rating of familiar real objects
171	Color emotions for multi-colored images
172	Colours in La Boca: Patrimonial identity in the Urban landscape
173	Goniocolorimetry: From measurement to representation in the CIELAB color space
174	Prediction of the spectrophotometric response of a carded fiber composed by different kinds of coloured raw materials: An artificial neural network-based approach
175	Statistical methods for analyzing color difference distributions
176	Munsell color science laboratory: Industrial short courses 2011
177	Experimental determination of laws of color harmony. Part 5: The harmony content of the various hue triads
178	Predictions of Munsell values with the same perceived lightness at any specified chroma irrespective of hues—Determination of any tonal colors
179	Why higher resolution graphics cards are needed in colour vision research
180	A tetrachromatic model for colorimetric use in mesopic vision
181	Comparing large colour-difference data sets
182	Color heterogeneity in visual search
183	Diffuse reflectance-factor measurements of rose petals
184	The 2nd CIE Expert Symposium on Appearance
185	Reflectance factor measurement systematic errors due to near infrared fluorescence
186	Color-difference formula performance for several datasets of small color differences based on visual uncertainty
187	Logo colour and differentiation: A new application of environmental colour mapping
188	Total appearance differences for metallic and pearlescent materials: Contributions from color and texture
189	Development of a comprehensive visual dataset based on a CIE blue color center: Assessment of color difference formulae using various statistical methods
190	Short-term memory of color sensation is robust against luminance distortion
191	Natural weathering of oak (Quercus petrae) and chestnut (Castanea sativa) coated with various finishes
192	Colour assays: An inside look into Alentejo traditional limewash paintings and coloured lime mortars

Appendix A2: A list of 10 academic colour books

	Author & Year	Book Titles		Author & Year	Book Titles
1	Itten, J. 2001	The elements of Color	2	Diane, and Cassidy, 2005	Colour forecasting
3	Feisner, A. 2006	Colour: how to use colour in art and design	4	Wright, A. 1999	The beginner's guide to colour psychology
5	Best, J. 2012	Colour design theories and applications	6	Wong, W. 1997	Principles of color design
7	Zelanski, P. and Fisher, M.P 1999	Colour	8	Geothe, J.W. 2006	Theory of colours
9	Holtzshue, L. 2006	Understanding color	10	Gage, J. 1999	Colour and meaning

Appendix B1: Interviews with designers and brand managers, Participant recruiting e-mail

Hello!

My name is Seahwa Won and I am a PhD Design Research student at Leeds University (under the supervision of Professor Stephen Westland).
I am contacting you in order to get expert opinion in my research as I feel your expertise would add and contribute significantly to the type of research that I am conducting.

My research topic is 'colour information in design'.
And interview is about how designers and brand managers decide colour
in their design process, and what types of colour references or tools they use.
There is no right or wrong answers to my questions, and the interview would
last about 30/40 minutes.
I would be very grateful if I can have email addresses of designers or
brand managers (middleweight or senior) working in your company.
So if possible, I would like to contact them directly to ask whether they are interested
in giving their valuable opinions.

May I expect your reply?
Thanks so much indeed
and sorry if my email is bothering you.

Best regards
Seahwa Won

Appendix B2: Interviews with designers and brand managers, Information sheet

INFORMATION SHEET

UNIVERSITY OF LEEDS

Before starting to participate in this interview, it is important that you read the following explanation.

About research

This research topic is 'colour information in design'.

And the interview is about how designers and brand managers decide colour in their design process, and what types of colour references or tools they use.

In addition, this activity will help develop a number of design concepts for colour information tool that will demonstrate findings.

- There is no right or wrong answers to my questions, and the interview would last about 30/40 minutes.
- This interview is to be recorded and used only for the research.
- After analysing the interview data, I will destroy all data.
- So your name and the name of your company will be anonymous so that you cannot be identified.

Appendix B3: Interviews with designers and brand managers, Informed consent form

<table>
<tr><td colspan="2" align="center">Consent to take part in [Colour information in design]</td></tr>
<tr><td></td><td>Add your initials next to the statement if you agree</td></tr>
<tr><td>I confirm that I have read and understand the information sheet dated [00/00/0000] explaining the above research project and I have had the opportunity to ask questions about the project.</td><td></td></tr>
<tr><td>I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason and without there being any negative consequences. In addition, should I not wish to answer any particular question or questions, I am free to decline.</td><td></td></tr>
<tr><td>I give permission for members of the research team to have access to my anonymised responses. I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the report or reports that result from the research.
I understand that my responses will be kept strictly confidential.</td><td></td></tr>
<tr><td>I agree for the data collected from me to be used in relevant future research in an anonymised form.</td><td></td></tr>
<tr><td>I agree to take part in the above research project and will inform the lead researcher should my contact details change.</td><td></td></tr>
</table>

<table>
<tr><td>Name of participant</td><td></td></tr>
<tr><td>Participant's signature</td><td></td></tr>
<tr><td>Date</td><td></td></tr>
<tr><td>Name of lead researcher</td><td></td></tr>
<tr><td>Signature</td><td></td></tr>
<tr><td>Date*</td><td></td></tr>
</table>

*To be signed and dated in the presence of the participant.

Once this has been signed by all parties the participant should receive a copy of the signed and dated participant consent form, the letter/ pre-written script/ information sheet and any other written information provided to the participants. A copy of the signed and dated consent form should be kept with the project's main documents which must be kept in a secure location.

Appendix B4: Interviews with designers and brand managers, Semi-structured interview protocol

RESEARCH PROTOCOL

UNIVERSITY OF LEEDS

Time of interview	
Date	
Place	
Interviewer	
Interviewee	

• Introduction and icebreaker

Hi <name of participant>. My name is <name of researcher> and I am a PhD student in the University of Leeds. I will conduct today's interview on colour in design strategy and design process.

1. How are you feeling today?
   • <respond>
2. Today's interview will help me explore the colour as useful information in design process. There are no right or wrong answers. I want you to feel relaxed and comfortable.
3. Are you ready to begin?
   • <respond>
4. Today's interview:
   • will begin by asking how you decide colour in your general design process.
   • Second I will ask which colour aspects you consider importantly in your design process and why you consider them.
   • Then I will ask whether you know any existing colour information or tools.
   • Lastly, I will ask your preferences and suggestions about colour information.
   • This interview is to be recorded and used only for the research. After analysing this interview data, I will destroy all data.
5. Would you have any questions at this point?
   • <respond>

Move to Interview

• **Participant**

    1.   Name

    [   ]

    2.   Age

    ① under 25 ② 26-35 ③ 36-45 ④ 46-55 ⑤ above 55

    3.   Gender

    ① male ② female

    4.   Job title

    [   ]

    5.   Years of work experience

    ① less than 1-2 years ② 3-5 years ③ 6-9 years ④ 10-19 years

    ⑤ more than 20 years

    6.   Number of employees

    [   ]

• **Interview**

    - Colour in a general design process (10 minutes)

    7.   Could you tell me what was your recent design work?

    [   ]

    8.   Could you tell me how you decided the colour?

    [   ]

    - Current usage of colour information (20 minutes)

    9.   What is the role of colour in the crisps category?

    [   ]

    10. If you were to pick one brand for re-design based on colour, which one would it be?

    [   ]

    11. What would be the changes?

    [   ]

    Now I'm going to explain 13 types of colour aspects you may consider importantly
    in your design process. Briefly explain showing the 13 cards. (Appendix B5)

12. For the crisps' packaging, what were important colour aspects? Why?

13. For the recent work, what were important colour aspects? Why?

14. In your general design process, what are important colour aspects?

15. You said that you consider these colour aspects *<showing the cards they picked>* importantly. Do you use any colour resources or information concerning these colour aspects?

16. If yes, where do you obtain the information? (book, website, colleague, etc)?

17. When and why do you use the information?

18. Are you satisfied with the information? Are they reliable?

19. Do you know about any other colour information? (colour forecasting report, etc)

20. If no, why don't you use them?

- Preferences (10 minutes)

21. Do you think using colour information would be helpful in your design process? Why?

22. What do you think about existing colour information? What do you prefer? Why?

23. What do you prefer among these 6 types of data presentation?

- Suggestions (20 minutes)

24. If I could develop an effective colour tool for you to use in the design process, what feature do you want? (age group, survey, timeline, intuitive, visual, etc)

• *Close*

25. Thank you for your time and contribution. Would you like to ask me any questions at this point? Would you like to be kept informed? • *<Respond>*

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Appendix B5: 13 types of colour information cards

Colour in art & design

Colour in art and design
refers to colours that famous artists or designers use or like

Colour harmony

Colour harmony
refers to colour combinations which arouse a pleasing effect

Colour history

Colour history
refers to how a particular colour was developed

Colour and light

Colour and light
refers to principles of light such as wavelengths and frequencies

Colour meaning

Colour symbolism
refers to particular colour meanings in different cultures or product categories

Colour measurement

Colour measurement
refers to measuring properties of colour or using colour measurement devices

Colour notation

Colour notation
refers to colour numbers or names to describe or communicate colour

Colour perception

Colour perception
refers to how colour draw people's attention

Colour preference

Colour preference
refers to people's favourite colour

Colour printing

Colour printing
refers to the quality or techniques of colour printing

Colour psychology

Colour psychology
refers to colour which makes people feels happy or excited

Colour theory

Colour theory
referes to systematic frameworks and rules intended to explain colour. For example, Munsell colour wheels or Newton's colour spectrum

Colour trend

Colour trend
refer to colours which are on-trend or popular for the coming season or year

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Appendix B6: Online survey questionnaire

Hello:
You are invited to participate in our survey about packaging colour.
In this survey, you will be asked 18 questions (5 for basic personal information / 13 for packaging colour).
It should take less than 5 minutes to complete the questionnaire.

Your participation in this study is completely voluntary.
There are no foreseeable risks associated with this project.
However, if you feel uncomfortable answering any questions, you can withdraw from the survey at any point. It is very important for us to learn your opinions.

Your survey responses will be strictly confidential and data from this research will be reported only in the aggregate. We will collect only basic personal information (such as age and gender) from which you cannot be identified. If you have questions at any time about the survey or the procedures, you may contact Seahwa Won (PhD student in Leeds University) by email at sdsw@leeds.ac.uk. This project was ethically reviewed at the University of Leeds.

Thank you very much for your time and support. There are no right or wrong answers. Please start with the survey now.

•Participant

1. Design industry
① Packaging
② Branding (CI/BI)
③ Graphic design
④ Product design
⑤ Interior design
⑥ Fashion design
⑦ Other

2. Years of experience
① less than 2 years ② 3-5 years ③ 6-9 years ④ 10-19 years ⑤ more than 20 years

3. Role / position
① Designer
② Design strategist
③ Brand manager
④ Colour consultant
⑤ Design academic / researcher
⑥ Freelancer
⑦ Other

4. Age
① Under 25
② 26-35
③ 36-45
④ 46-55
⑤ above 55

5. Gender

① Male　② Female

• Colour aspects

6. In your design strategy or design process, how important (on a scale of 0-100) is it for you to know the colours that famous artists or designers use or like?

0   100

7. In your design strategy or design process, how important is it for you to know which colour combinations arouse a pleasing effect?

0   100

8. In your design strategy or design process, how important is it for you to know how a particular colour was developed?

0   100

9. In your design strategy or design process, how important is it for you to know principles of light such as wavelengths and frequencies?

0   100

10. In your design strategy or design process, how important is it for you to know that colour conveys particular meanings in different cultures or product categories?

11. In your design strategy or design process, how important is it for you to measure colour or use colour measurement devices?

12. In your design strategy or design process, how important is it for you to know either colour numbers or names?

13. In your design strategy or design process, how important is it for you know how colour draw people's attention?

14. In your design strategy or design process, how important is it for you to know which colour is the people's favourite colour?
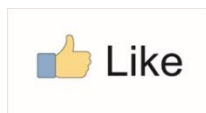
15. In your design strategy or design process, how important is it that the quality of colour printing is good?


```
0                                                    100
```

16. In your design strategy or design process, how important is it for you to know which colour makes people feel happy or excited?


```
0                                                    100
```

17. In your design strategy or design process, how important is it for you to know colour theories such as Munsell colour wheels or Newton's colour spectrum?


```
0                                                    100
```

18. In your design strategy or design process, how important is it for you to know which colours are on-trend or popular for the coming season or year?


```
0                                                    100
```

•Close
Thank you for your time and contribution.

Appendix B7: Descriptive statistics

|		N	Minimum	Maximum	Mean	Std. Deviation	Variance	Skew ness		Kurtosis	
		Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Art and design	Designer	23	1.0	81.0	32.174	27.9702	782.332	.513	.481	-1.043	.935
	Brand manager	28	1.0	99.0	32.929	28.2396	797.476	.854	.441	-.271	.858
	Researcher	11	7.0	101.0	55.636	31.6774	1003.455	-.413	.661	-1.041	1.279
Harmony	Designer	23	21.0	101.0	82.478	23.1632	536.534	-1.530	.481	1.579	.935
	Brand manager	28	1.0	101.0	80.607	28.9269	836.766	-2.030	.441	3.350	.858
	Researcher	11	50.0	101.0	85.364	18.5379	343.655	-1.241	.661	.293	1.279
History	Designer	23	1.0	99.0	33.130	26.7977	718.119	.684	.481	-.155	.935
	Brand manager	28	1.0	101.0	30.357	33.1140	1096.534	1.042	.441	-.283	.858
	Researcher	11	3.0	76.0	44.273	25.0403	627.018	-.389	.661	-1.179	1.279
Light	Designer	23	1.0	85.0	37.565	31.1839	972.439	.298	.481	-1.607	.935
	Brand manager	28	1.0	101.0	29.607	32.2149	1037.803	1.192	.441	.205	.858
	Researcher	11	3.0	82.0	45.000	25.4323	646.800	-.102	.661	-.942	1.279
Meaning	Designer	23	16.0	100.0	78.087	23.6910	561.265	-1.360	.481	1.154	.935
	Brand manager	28	1.0	101.0	76.929	27.0335	730.810	-1.333	.441	1.500	.858
	Researcher	11	70.0	101.0	94.818	8.8070	77.564	-2.601	.661	7.545	1.279
Measurement	Designer	23	1.0	96.0	41.739	33.8972	1149.020	.261	.481	-1.444	.935
	Brand manager	28	1.0	101.0	49.464	40.6835	1655.147	.117	.441	-1.772	.858
	Researcher	11	3.0	77.0	41.364	23.6612	559.855	-.214	.661	-.396	1.279
Notation	Designer	23	1.0	99.0	61.522	29.8098	888.625	-.745	.481	-.466	.935
	Brand manager	28	1.0	101.0	77.607	34.1080	1163.358	-1.361	.441	.313	.858
	Researcher	11	21.0	101.0	66.000	28.9413	837.600	-.178	.661	-1.543	1.279
Perception	Designer	23	6.0	100.0	71.739	30.9299	956.656	-1.008	.481	-.206	.935
	Brand manager	28	13.0	101.0	76.286	28.6949	823.397	-.910	.441	-.480	.858
	Researcher	11	31.0	101.0	83.636	20.4659	418.855	-1.929	.661	4.187	1.279
Preference	Designer	23	2.0	99.0	55.739	34.5283	1192.202	-.423	.481	-1.317	.935
	Brand manager	28	11.0	99.0	70.964	28.7717	827.813	-.835	.441	-.350	.858
	Researcher	11	12.0	101.0	56.818	29.5460	872.964	-.173	.661	-.936	1.279
Printing	Designer	23	9.0	101.0	86.609	21.9747	482.885	-2.368	.481	6.416	.935
	Brand manager	28	1.0	101.0	84.250	26.3391	693.750	-1.860	.441	2.883	.858
	Researcher	11	36.0	101.0	88.182	20.2574	410.364	-2.022	.661	4.180	1.279
Psychology	Designer	23	15.0	100.0	75.043	24.1199	581.771	-1.112	.481	.487	.935
	Brand manager	28	13.0	99.0	79.536	27.0356	730.925	-1.470	.441	.941	.858
	Researcher	11	27.0	101.0	78.273	27.8715	776.818	-.889	.661	-.903	1.279
Theory	Designer	23	1.0	101.0	71.130	29.2843	857.573	-1.205	.481	.652	.935
	Brand manager	28	1.0	99.0	53.393	35.3201	1247.507	-.035	.441	-1.460	.858
	Researcher	11	20.0	101.0	72.909	25.1295	631.491	-1.061	.661	.757	1.279
Trend	Designer	23	1.0	100.0	60.609	33.8536	1146.067	-.485	.481	-1.191	.935
	Brand manager	28	1.0	101.0	53.750	36.4200	1326.417	.046	.441	-1.680	.858
	Researcher	11	16.0	101.0	67.455	31.9417	1020.273	-.463	.661	-1.441	1.279

Appendix C1: Yxy values measured by the spectraradiometer

	Colour	Y	x	y		Colour	Y	x	y
1		191	0.375	0.372	28		45	0.294	0.508
2		0.69	0.303	0.297	29		33.3	0.585	0.325
3		13.8	0.172	0.127	30		200	0.444	0.492
4		46.2	0.295	0.514	31		185	0.373	0.37
5		33.7	0.592	0.326	32		0.76	0.3	0.283
6		203	0.446	0.492	33		13.7	0.174	0.128
7		188	0.376	0.37	34		44.8	0.294	0.506
8		1.24	0.299	0.306	35		41.9	59.1	0.326
9		14.1	0.175	0.129	36		203	0.446	0.492
10		46.4	0.296	0.508	37		189	0.372	0.371
11		34.7	0.588	0.325	38		1.11	0.297	0.301
12		206	0.445	0.491	39		13.5	0.174	0.129
13		188	0.375	0.371	40		44.6	0.296	0.512
14		0.65	0.29	0.29	41		30.8	0.588	0.326
15		13.7	0.172	0.125	42		172	0.442	0.49
16		45.3	0.295	0.511	43		149	0.377	0.367
17		41.4	0.592	0.324	44		0.68	0.3	0.287
18		204	0.445	0.492	45		32.9	0.191	0.198
19		189	0.375	0.372	46		59.1	0.295	0.553

20		0.83	0.293	0.287	47		30.8	0.628	0.334
21		13.8	0.172	0.122	48		164	0.46	0.48
22		45.2	0.293	0.508	49		111	0.408	0.385
23		41.4	0.588	0.326	50		6.97	0.313	0.318
24		205	0.443	0.494	51		35.9	0.187	0.192
25		185	0.374	0.371	52		45.6	0.294	0.512
26		0.99	0.298	0.294	53		13.6	0.555	0.323
27		13.9	0.174	0.129	54		162	0.457	0.483

Appendix C2: Colour meaning experiment, Packaging images
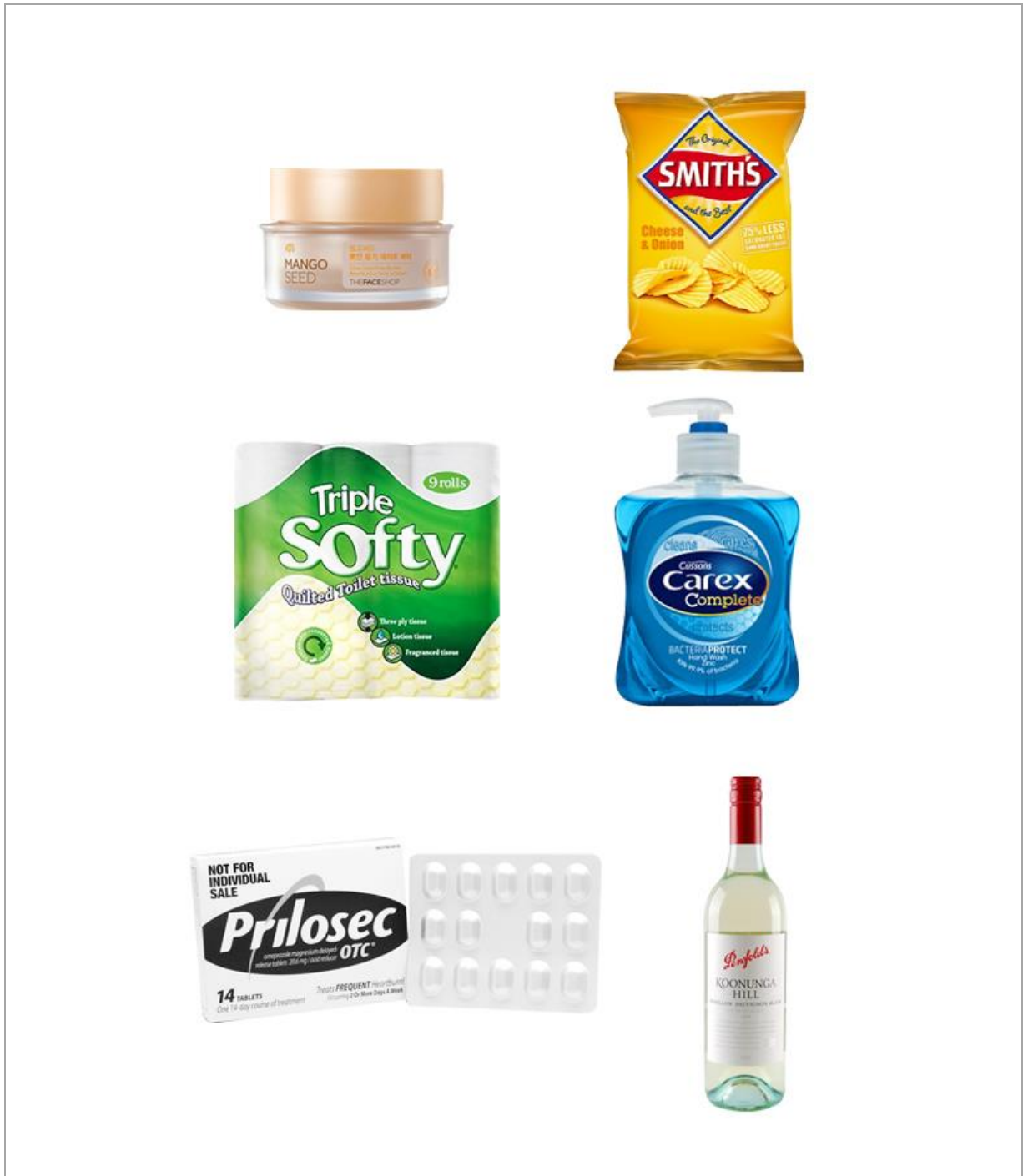
Appendix C3: Colour meaning experiment, Information sheet

Title of the study
Colour information in design

About this experiment
This experiment aims to explore the relationship between colour meaning and context.

A total of 54 simplified packaging images with 5 bi-polar words are randomly displayed on a computer screen as shown in the figure below. This includes two experimental phases. In part A, 42 images including simple colour patches and simplified packaging images are presented as the stimuli. In part B, 12 images including simple colour patches and real-world packaging images are presented as the stimuli.

Masculine		Feminine
	0	
Warm		Cold
	0	
Expensive		Inexpensive
	0	
Modern		Traditional
	0	
Elegant		Vulgar
	0	

What about confidentiality?
This research has been approved by the University of Leeds Research Ethics committee (Ethics reference: LTDESN-042).

Before starting this experiment, I will take your informed consent. After analysing the data, I will destroy all data. So your name and the name of your company will be anonymous so that you cannot be identified.

Seahwa Won
PHD Research Project
University of Leeds
sdsw@leeds.ac.uk

Appendix C4: Colour meaning experiment, Informed consent form

Consent to take part in [Colour information in design]

	Add your initials next to the statement if you agree
I confirm that I have read and understand the information sheet dated [00/00/0000] explaining the above research project and I have had the opportunity to ask questions about the project.	
I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason and without there being any negative consequences. In addition, should I not wish to answer any particular question or questions, I am free to decline.	
I give permission for members of the research team to have access to my anonymised responses. I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the report or reports that result from the research. I understand that my responses will be kept strictly confidential.	
I agree for the data collected from me to be used in relevant future research in an anonymised form.	
I agree to take part in the above research project and will inform the lead researcher should my contact details change.	

Name of participant	
Participant's signature	
Date	
Name of lead researcher	
Signature	
Date*	

*To be signed and dated in the presence of the participant.

Once this has been signed by all parties the participant should receive a copy of the signed and dated participant consent form, the letter/ pre-written script/ information sheet and any other written information provided to the participants. A copy of the signed and dated consent form should be kept with the project's main documents which must be kept in a secure location.

Appendix C5: Descriptive statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Beige_Colour chip	25	49.5413	100.0000	75.938840	16.5100979	272.583	.007	.464	-1.228	.902
Beige_Cosmetic	25	50.0000	100.0000	77.755352	14.4976018	210.180	.085	.464	-.931	.902
Beige_Crisp	25	9.0214	93.2722	59.987772	17.1843678	295.302	-.715	.464	2.177	.902
Beige_Hand wash	25	49.5413	100.0000	72.489296	13.8124807	190.785	.109	.464	-.448	.902
Beige_Medicine	25	49.6942	100.0000	69.541288	13.6842972	187.260	.891	.464	.271	.902
Beige_Toilet tissue	25	43.2722	100.0000	70.415904	16.2623159	264.463	.317	.464	-1.042	.902
Beige_White wine	25	8.5321	100.0000	66.567588	19.0938645	364.576	-.767	.464	2.473	.902
Beige_PartB_Colour chip	25	46.6361	100.0000	74.103960	14.5556643	211.867	.071	.464	-.689	.902
Beige_PartB_Cosmetic	25	59.7859	100.0000	81.051992	13.4890651	181.955	.078	.464	-1.338	.902
Black_Colour chip	25	.0000	50.6116	25.688072	20.0734332	402.943	.043	.464	-1.726	.902
Black_Cosmetic	25	.0000	88.0734	40.214072	25.9466514	673.229	-.274	.464	-1.172	.902
Black_Crisp	25	.0000	50.1529	21.437300	18.5283114	343.298	.328	.464	-1.409	.902
Black_Hand wash	25	.0000	50.9174	17.370028	16.9775178	288.236	.744	.464	-.783	.902
Black_Medicine	25	.0000	75.0765	27.088684	18.3206711	335.647	.543	.464	.298	.902
Black_Toilet tissue	25	.0000	49.2355	20.108384	15.5637474	242.230	.265	.464	-.839	.902
Black_White wine	25	.0000	49.8471	23.180440	17.9029182	320.514	.077	.464	-1.484	.902
Black_PartB_Colour chip	25	.0000	50.3058	24.685016	19.2696534	371.320	.195	.464	-1.526	.902
Black_PartB_Medicine	25	.0000	49.8471	24.171248	14.7061409	216.271	-.187	.464	-.804	.902
Blue_Colour chip	25	.9174	49.8471	24.152912	14.5643346	212.120	.285	.464	-.874	.902
Blue_Cosmetic	25	9.9388	96.3303	38.538228	17.3726120	301.808	1.469	.464	4.252	.902
Blue_Crisp	25	8.1040	48.1651	28.960236	12.3309232	152.052	-.081	.464	-1.108	.902
Blue_Hand wash	25	3.0581	49.5413	27.529064	12.0625299	145.505	-.170	.464	-.434	.902
Blue_Medicine	25	7.0336	51.8349	30.581036	10.8810110	118.396	.067	.464	.352	.902
Blue_Toilet tissue	25	.9174	50.7645	33.015280	12.4817756	155.795	-.769	.464	.332	.902
Blue_White wine	25	5.1988	60.7034	31.070340	13.5745095	184.267	.095	.464	-.445	.902
Blue_PartB_Colour chip	25	4.8930	70.9480	31.498476	14.4495325	208.789	1.069	.464	2.200	.902
Blue_PartB_Hand wash	25	11.0092	65.9021	30.917432	13.0450518	170.173	.661	.464	.676	.902
Green_Colour chip	25	9.4801	64.2202	37.810400	15.7256854	247.297	-.274	.464	-.986	.902
Green_Cosmetic	25	16.3609	82.8746	47.155968	18.3937951	338.332	-.178	.464	-.895	.902
Green_Crisp	25	10.3976	75.8410	38.281356	15.1995825	231.027	.213	.464	.189	.902
Green_Hand wash	25	20.0306	79.5107	42.428140	15.7423077	247.820	.686	.464	-.094	.902
Green_Medicine	25	11.1621	65.5963	40.195716	15.0345089	226.036	-.109	.464	-.880	.902
Green_Toilet tissue	25	20.0306	95.8716	45.657492	15.1630110	229.917	1.207	.464	4.172	.902
Green_White wine	25	8.1040	74.4648	42.636084	15.8735463	251.969	-.287	.464	.442	.902
Green_PartB_Colour chip	25	17.8899	72.3242	40.985940	14.6561669	214.803	.407	.464	-.652	.902
Green_PartB_Toilet tissue	25	21.7125	71.4067	48.740068	15.2382155	232.203	-.016	.464	-1.164	.902
Red_Colour chip	25	19.4190	100.0000	72.727832	25.2311265	636.610	-.779	.464	-.447	.902
Red_Cosmetic	25	25.2294	100.0000	77.889908	17.9432989	321.962	-.908	.464	1.598	.902
Red_Crisp	25	21.2538	100.0000	67.504592	25.5137982	650.954	-.320	.464	-1.195	.902

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Red_Hand wash	25	12.9969	99.3884	69.889920	22.7302613	516.665	-.697	.464	-.175	.902
Red_Medicine	25	21.5596	98.6239	61.981664	19.0583719	363.222	-.105	.464	-.461	.902
Red_Toilet tissue	25	21.2538	99.0826	68.746176	21.6658373	469.409	-.556	.464	-.370	.902
Red_White wine	25	18.1957	98.1651	67.070340	21.0206065	441.866	-.753	.464	-.068	.902
Red_PartB_Colour chip	25	30.2752	100.0000	71.431200	20.3401132	413.720	-.705	.464	-.373	.902
Red_PartB_White wine	25	19.8777	92.6606	62.868508	21.2447816	451.341	-.760	.464	-.515	.902
Yellow _Colour chip	25	20.7951	97.4006	65.021416	18.0195516	324.704	-.238	.464	.133	.902
Yellow _Cosmetic	25	43.2722	93.8838	68.764532	15.1358432	229.094	-.187	.464	-1.077	.902
Yellow _Crisp	25	1.5291	90.9786	55.186556	20.1121142	404.497	-.426	.464	1.057	.902
Yellow _Hand wash	25	29.8165	100.0000	64.385320	17.7947400	316.653	.338	.464	-.310	.902
Yellow _Medicine	25	29.8165	76.4526	59.235472	10.9163107	119.166	-.817	.464	1.298	.902
Yellow _Toilet tissue	25	42.0489	96.4832	67.500908	14.7911911	218.779	.526	.464	-.213	.902
Yellow _White wine	25	21.4067	100.0000	62.379208	20.6331170	425.726	-.288	.464	-.418	.902
Yellow _PartB_Colour chip	25	35.0153	91.1315	65.785932	15.4273503	238.003	-.132	.464	-.797	.902
Yellow _PartB_Crisp	25	8.4098	89.1437	49.804280	16.0837506	258.687	-.375	.464	1.816	.902

Appendix D1: A list of current washing-up liquid products available in UK

Brand name	Proprietary brand								
Fairy	Original	Lemon	Apple & Lime	Pomegranate	Eucalyptus	Citrus	Rose	Aloe Vera & Cucumber	Platinum
Persil		Lemon	Apple			Orange	Pink blush		
Morning fresh	Original	Lemon	Lime				Sensitive		
Ecover		Mango & Shea butter	Lemon	Pomegranate	Camomile & Marigold				
Method		Lemon mint				Clementine		Cucumber	

Surface								Sensitive
Own-label brand								
Waitrose	Original	Citrus	Cucumber & Basil	Apple	Sea grass		Lavender	Sensitive
Sainsbury's	Original	Lemon	Apple	Cherry blossom				
Tesco	Original	Lemon & Lime	Apple	Cherry & Orchid		Orange		
Morrison	Original	Lemon	Apple			Orange	Summer	

Appendix D2: Case study, Interview information sheet and questions

INFORMATION SHEET

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This interview will ask you what is important factor when you buy a washing-up liquid (the liquid used for manual washing in the sink – not for use in automatic machines).

This interview time will be around 15 minutes and is to be recorded and used only for the research.

After analysing this interview data, I will destroy all data.

Would you have any questions at this point?

▪ Age

① 25 and under ② 26-35 ③ 36-45 ④ 46-55 ⑤ above 55

▪ Gender

① male ② female

▪ Living status

① Multi person non-family household ② Single person household ③ Family/partner ④ Other

Interview questions

1. Do you cook? Do you buy a washing-up liquid?

2. How often do you buy a washing-up liquid?

3. Where do you shop for a washing-up liquid most often?

4. What elements are important to you when you buy a washing-up liquid?

5. Why the particular element is important?

6. What elements are not important to you?

7. Why the particular element is not important?

8. What do you expect from the colour of the washing-up liquid (or packaging)?

9. If the product (or packaging) colour meets you expectation, would it be influencing your purchase?

Appendix D3: Case study, Informed consent form

Consent to take part in [Colour information in design]

	Add your initials next to the statement if you agree
I confirm that I have read and understand the information sheet dated [00/00/0000] explaining the above research project and I have had the opportunity to ask questions about the project.	
I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason and without there being any negative consequences. In addition, should I not wish to answer any particular question or questions, I am free to decline.	
I give permission for members of the research team to have access to my anonymised responses. I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the report or reports that result from the research. I understand that my responses will be kept strictly confidential.	
I agree for the data collected from me to be used in relevant future research in an anonymised form.	
I agree to take part in the above research project and will inform the lead researcher should my contact details change.	

Name of participant	
Participant's signature	
Date	
Name of lead researcher	
Signature	
Date*	

*To be signed and dated in the presence of the participant.

Once this has been signed by all parties the participant should receive a copy of the signed and dated participant consent form, the letter/ pre-written script/ information sheet and any other written information provided to the participants. A copy of the signed and dated consent form should be kept with the project's main documents which must be kept in a secure location.

Appendix D4: Case study, Online survey questionnaire

Washing-up liquid product

Welcome to My Survey

Hello:
Before starting this questionnaire, one participant screening question will be asked.
Have you bought a washing-up liquid product in the last one year period?
If no, please do not take part in this questionnaire.
If yes, please continue this.

Next

Washing-up liquid product

Welcome to My Survey

You are invited to participate in our survey about **washing-up liquid product** (the product used **for manual washing in the sink** – not for use in automatic machines).

In this survey, you will be asked 10 questions (4 for basic personal information / 6 for washing-up liquid product). It should take less than 2 minutes to complete the questionnaire. Your participation in this study is completely voluntary. There are no foreseeable risks associated with this project. However, if you feel uncomfortable answering any questions, you can withdraw from the survey at any point. It is very important for us to learn your opinions.

Your survey responses will be strictly confidential and data from this research will be reported only in the aggregate. We will collect only basic personal information (such as age and gender) from which you cannot be identified. If you have questions at any time about the survey or the procedures, you may contact Seahwa Won (PhD student in Leeds University) by email at sdsw@leeds.ac.uk. This project was ethically reviewed at the University of Leeds.

Thank you very much for your time and support. There are no right or wrong answers. Please start with the survey now.

Prev   Next

Washing-up liquid product

General information

This section consists of 4 questions out of 10.

* **1. Age**
- ◯ 25 and under
- ◯ 26-35
- ◯ 36-45
- ◯ 46-55
- ◯ above 55

* **2. Gender**
- ◯ Male
- ◯ Female

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* 3. Region where you are

  ◯ UK

  ◯ Other European countries except UK

  ◯ Asia

  ◯ USA

  ◯ Other (please specify)

    [   ]

* 4. Living status

  ◯ Multi person non-family household

  ◯ Single person household

  ◯ Family/partner

  ◯ Other (please specify)

    [   ]

[Prev] [Next]

Washing-up liquid product

Shopping behaviour

This section consists of 3 questions out of 10.

* 5. Do you buy a washing-up liquid product?

  ◯ Yes

  ◯ No

* 6. How often do you buy a washing-up liquid product?

  ◯ Every two weeks

  ◯ Every month

  ◯ Every two months

  ◯ Twice a year

  ◯ Other (please specify)

    [   ]

* 7. Where do you shop for a washing-up liquid product?

  ◯ Large supermarkets

  ◯ Internet delivery

  ◯ Small shops

  ◯ Other (please specify)

    [   ]

[Prev] [Next]

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Washing-up liquid product

Shopping behaviour

This section consists of 3 questions out of 10.

* 8. Which of the following Factors would you say influenced you when purchasing a washing-up liquid product?
(Please tick checkboxes as many as is applicable)

☐ Colour of packaging (or colour of liquid)

☐ Size of packaging

☐ Safety of the product

☐ Shape of packaging

☐ Efficacy of the product

☐ Price of the product

☐ Smell of the product

☐ Brand of the product

☐ Other (please specify)

[   ]

9. In question 8, if you chose "Smell of the product", please specify what types of smell you want or like.

[   ]

10. In question 8, if you chose "Brand of the product", please specify the brand name.

[   ]

[Prev] [Done]

Appendix D5: Case study, Colour experiment information sheet

INFORMATION SHEET
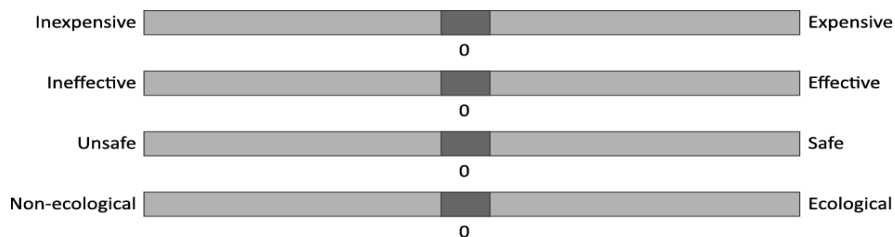
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Title of the study
Colour information in design

About this experiment
This experiment aims to explore possible colours for washing-up liquid packaging.

A total of 19 simplified packaging images with 4 bi-polar words are randomly displayed on a computer screen as shown in the figure below.

Inexpensive		Expensive
Ineffective		Effective
Unsafe		Safe
Non-ecological		Ecological

What about confidentiality?
This research has been approved by the University of Leeds Research Ethics committee (Ethics reference: LTDESN-042).

Before starting this experiment, I will take your informed consent. After analysing the data, I will destroy all data. So your name and the name of your company will be anonymous so that you cannot be identified.

Seahwa Won
PHD Research Project
University of Leeds
sdsw@leeds.ac.uk

Appendix D6: Descriptive statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Variance	Skew ness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Packaging ID 1	25	22.3242	94.4954	51.449528	18.0121805	324.439	.559	.464	-.097	.902
Packaging ID 2	25	10.2446	97.5535	50.097856	21.7057158	471.138	.135	.464	-.312	.902
Packaging ID 3	25	11.1621	98.7768	49.370036	23.9590088	574.034	-.050	.464	-.860	.902
Packaging ID 4	25	1.0703	100.0000	45.058100	29.8488595	890.954	.238	.464	-1.157	.902
Packaging ID 5	25	20.6422	86.8502	53.100924	17.8286836	317.862	.308	.464	-.522	.902
Packaging ID 6	25	9.6330	94.0367	52.990824	24.0111136	576.534	-.201	.464	-.631	.902
Packaging ID 7	25	1.9878	92.6606	48.727832	30.3947508	923.841	-.035	.464	-1.186	.902
Packaging ID 8	25	16.5138	94.8012	56.501536	17.9026971	320.507	.114	.464	.141	.902
Packaging ID 9	25	22.1713	95.8716	56.605508	20.0058575	400.234	.153	.464	-.640	.902
Packaging ID 10	25	12.0795	85.9327	51.522940	21.7920503	474.893	-.262	.464	-.911	.902
Packaging ID 11	25	29.3578	100.0000	48.275232	16.5830250	274.997	1.424	.464	2.544	.902
Packaging ID 12	25	18.6544	100.0000	62.446480	23.6246819	558.126	-.062	.464	-1.076	.902
Packaging ID 13	25	20.3364	100.0000	64.195716	21.0016862	441.071	-.160	.464	-.515	.902
Packaging ID 14	25	27.8287	88.6850	54.458720	15.9288702	253.729	.257	.464	-.553	.902
Packaging ID 15	25	9.3272	74.9235	41.241588	20.0772866	403.097	.140	.464	-1.256	.902
Packaging ID 16	25	1.5291	85.1682	36.409800	27.4045442	751.009	.408	.464	-1.045	.902
Packaging ID 17	25	20.7951	97.8593	53.944956	21.4485595	460.041	.471	.464	-.444	.902
Packaging ID 18	25	8.7156	97.8593	55.021416	23.5311998	553.717	.102	.464	-.155	.902
Packaging ID 19	25	11.7737	97.4006	50.474612	23.6871689	561.082	.280	.464	-.447	.902

Appendix D7: Case study, Interview with a brand manager, information sheet

Packaging Colour for Washing-Up Liquid

Seahwa Won and Prof. Stephen Westland
School of Design
sdsw@leeds.ac.uk

STUDY AIM
The aim of this case study is to explore which green colour is appropriate for a washing-up liquid packaging.

OUR EXPECTATION OF YOU
To collect your opinions for the packaging colours developed in this project and the usefulness of this kind of information in your packaging development process.


METHOD
PACKAGING COLOUR DEVELOPMENT PROCESS

INTERVIEW ➡ **ONLINE SURVEY** ➡ **COLOUR EXPERIMENT**

- to identify important elements when consumers purchase a washing-up liquid
  10 participants were interviewed in person

- to identify important elements when consumers purchase a washing-up liquid
  73 participants took part in the survey

- to identify which green best represent expensive-inexpensive, effective-ineffective, safe-unsafe and eco friendly-non-eco friendly
  25 participants rated 19 images over the four bi-polar terms

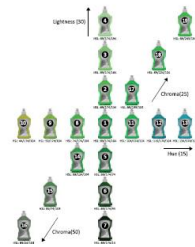---

RESULT OF INTERVIEWS AND ONLINE SURVEY
DETERMINANTS OF PRODUCT CHOICE
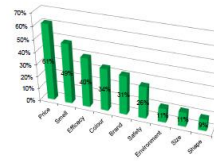
Consumers consider

- PRICE
- SMELL
- EFFICACY
- COLOUR
- BRAND
- SAFETY
- ENVIRONMENT

COLOUR EXPERIMENT

Selection of colour stimuli
One particular colour was randomly selected from Fairy's Original product which is a leading brand in the product category and 19 colours were elaborated based on different lightness, chroma and hue ranges

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COLOUR EXPERIMENT

| PRICE | Efficacy |
| Expensive-Inexpensive | Effective-Ineffective |

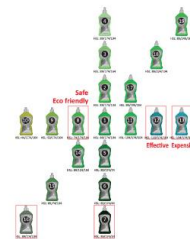| Safety | Environment |
| Safe-Unsafe | Environmentally friendly-Non environmentally friendly |

Selection of bi-polar terms
4 bi-polar terms were selected relating to the 4 product choice determinants (price, efficacy, safety and environment) out of 9 which were derived from interviews and online survey (see page3)
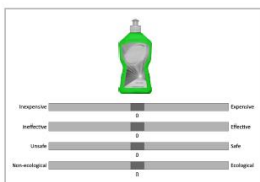
COLOUR EXPERIMENT

Process
25 participants rated 19 packaging images over the 4 bi-polar terms.

Inexpensive — Expensive
Ineffective — Effective
Unsafe — Safe
Non-ecological — Ecological

RESULT of COLOUR EXPERIMENT

Expensive - Inexpensive
Packaging ID 13 is perceived as the most expensive.
Packaging ID 16 is perceived as the most inexpensive.

Effective – Ineffective
Packaging ID 12 is perceived as the most effective.
Packaging ID 16 is perceived as the most ineffective.

Safe – Unsafe
Packaging ID 8 is perceived as the most safe.
Packaging ID 7 is perceived as the most unsafe.

Eco friendly – Non eco friendly
Packaging ID 8 is perceived as the most eco friendly.
Packaging ID 16 is perceived as the most non-eco friendly.

WHAT WILL YOU BE ASKED
NUMBER OF INTERVIEW QUESTIONS: 6
EXPECTED DURATION TIME: 40 minutes

Q1. What is your role within packaging design in your company?

Q2. Could you describe the packaging design process?

Q3. Could you describe how you decide colours for your product packaging?

Q4. How do you evaluate whether your packaging design is successful or not?

Q5. Could you describe how this information can be used in your design process?

Q6. Could you describe any colour resources or tools you use in your design process?

THANK YOU!!!

Appendix E1: CMCW, Refinement questionnaire

E-MAIL INTERVIEW WITH DESIGNERS AND BRAND MANAGERS

Thank you for participating in this project!

The aim of this project is to refine and improve the initial concept of a colour website.

The concept name is Colourpedia.

There is no right or wrong answer. According to your feedback, this initial concept could be changed. Any feedback from you will be very useful and helpful. Please fill the below form and send it to sdsw@leeds.ac.uk.

Name of participant	
Date	

Please tick (x) and leave the detail comments.

Website content's quality	Exemplary	Adequate	Unacceptable
Have the suggestions provided by you been met?			
Is the depth and scope of the information appropriate?			
Do the website contents enhance visitors' interest?			
Is the information reliable?			
Please write your comment (no word limit). e.g. is there any content you want to add or delete?			

Design	Exemplary	Adequate	Unacceptable
Is the site's design aesthetically appealing?			
Please write your comment (no word limit).			

Navigation	Exemplary	Adequate	Unacceptable
Are links for navigation clearly labelled to allow the user to easily move to related pages and not to become lost?			
Please write your comment (no word limit).			

Layout	Exemplary	Adequate	Unacceptable

Is information organised for clear and easy understanding?			
Please write your comment (no word limit).			

Choice of colour	Exemplary	Adequate	Unacceptable
Do the colours of the background, fonts and links detract from the content, and are they consistent across pages?			
Please write your comment (no word limit).			

Image	Exemplary	Adequate	Unacceptable
Do the graphic images enhance the information?			
Please write your comment (no word limit).			

Font	Exemplary	Adequate	Unacceptable
Are the fonts appropriate to read?			
Please write your comment (no word limit).			

Overall	Yes	Not yet	No
Would you recommend this site to others?			
Please write your overall feedback to improve this initial concept (no word limit).			
Thank you for your feedback! Please send this form to sdsw@leeds.ac.uk. After sending me this, it will be always welcome for you to give me any feedback whenever and whatever you like.			

Appendix E2: CMCW, Refinement e-mail message

Dear 000

Hello!

This is Seahwa Won who interviewed you a couple of months ago.

How are you? Hope you are well.

I would like to say thank you again for all your help.

With your help I finished face to face interviews.

And based on the interview findings, I've developed a concept of colour website.

Do you remember that I asked you to give me feedback on the initial concept?

I'm writing this email to ask your feedback on the concept.

The concept name is 'Colourpedia'.

The aim of getting your feedback is to refine and improve the initial concept.

According to your feedback, this concept could be changed.

Any feedback from you will be very useful and helpful.

I attached two files (a PDF for explaining the concept, a word file for collecting your feedback).

Could you please review the concept and may I ask your detailed feedback as soon as possible?

Thanks so much indeed

and sorry for interrupting your busy schedule.

Best regards

Seahwa Won

<concept_Seahwa Won.pdf><feedback_Seahwa Won.docx>

Appendix F1: Expert evaluation questionnaire

EXPERT REVIEW			
Name of participant		Date	
Job title		Name of company/institution	

I've looked through the given links of the TUTORIAL and the COLOURPEDIA. Yes ☐ No ☐

- TUTORIAL: http://colourpedia.org/expert.html

- COLOURPEDIA: http://colourpedia.org/index_.html

SECTION A

1. Colourpedia is a colour-meaning-centred website.
   What are your first impressions about the concept of the website?
   Please comment:

2. Do you think the concept of the colour-meaning-centred website (Colourpedia) is clear to you?
   Yes ☐   No ☐
   If you chose No in question 2, could you explain why?

3. What are the strengths of Colourpedia? (contents/design/ease of use/others)
   Please comment:

4. What are the weaknesses of Colourpedia? (contents/design/ease of use/others)
   Please comment:

5. What types of support do you think Colourpedia could provide to professional users such as
   designers, brand managers, brand/market researchers, etc?
   (Please tick checkboxes as many as is applicable)
   Save time & effort   ☐
   Understanding & insight   ☐
   Colour decision   ☐
   Creativity & inspiration   ☐
   Colour strategy   ☐
   Others (please specify)

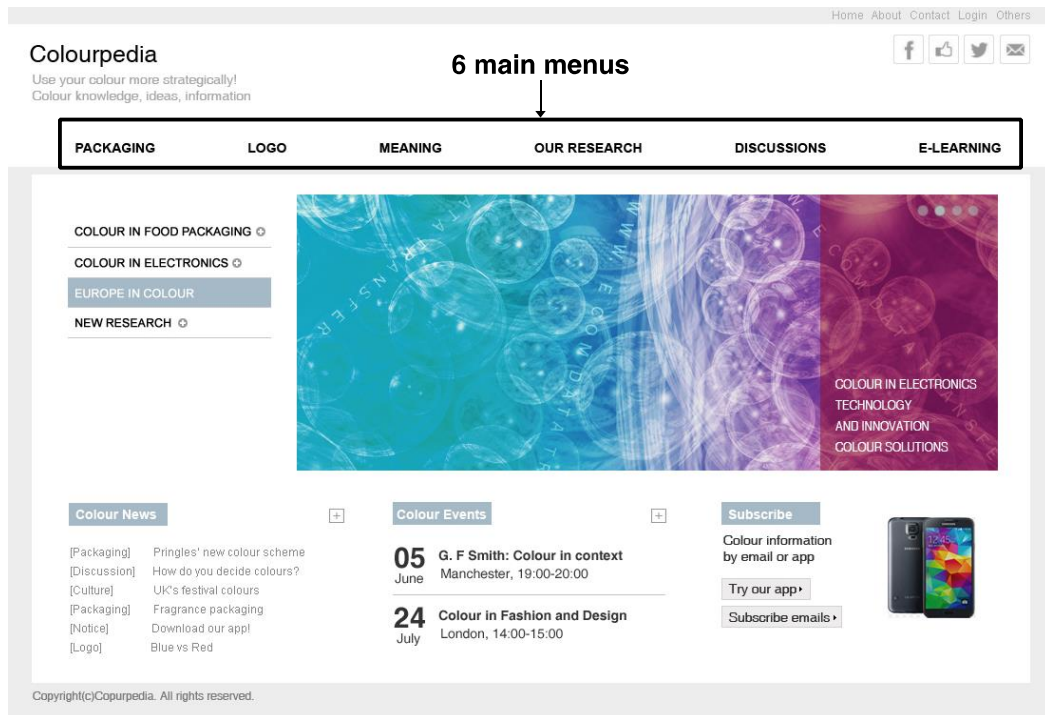6. These are six main menus on Colourpedia as shown in Figure 1.

Figure 1. Six main menus of Colourpedia

6-1. Which menus of six would be useful for professional users such as designers, brand managers, brand/market researchers, etc? Please see the TUTORIAL if necessary (http://www.colourpedia.org/expert.html).
(Please tick checkboxes as many as is applicable)

Packaging menu ☐
Logo menu ☐
Meaning menu ☐
Our research menu ☐
Discussions menu ☐
E-learning menu ☐

6-2. Could you explain your choices in question 6-1?
Please comment:

7. What additional features would you like to see on Colourpedia?
Please comment:

SECTION B

8. The following is a set of questions to evaluate the acceptance of the website's concept.
Imagine there is a slide bar as shown in Figure 2.
Please score each of the questions below with any value between 0 and 100.

(For guidance, 0 = of no value; 50 = acceptable; 100 = exemplary)

Figure 2. A slide bar indicating the value between 0-100.

Quality of website's content	Score
a. Is the website's content useful for packaging and branding industry?	( )
b. Is the depth and scope of website's content appropriate?	( )
c. Does the website's content enhance visitors' interest?	( )
d. Is the website's content reliable?	( )
If you have rated any of **_a-d questions_** below 50 points, please explain why.	

Design & Ease of use	Score
e. Is the site's design aesthetically appealing?	( )
f. Are links for navigation clearly labelled to allow the reader to easily to related pages and not to become lost?	( )
g. Is information arranged for clear and easy understanding?	( )
h. Do the colours of the background, fonts and links detract from the content, and are they consistent across pages?	( )
i. Do the graphic images enhance the information?	( )
j. Are the fonts appropriate to read?	( )
If you have rated any of **_e-j questions_** below 50 points, please explain why.	

SECTION C

9. The following is a set of some existing colour websites including Colourpedia.

   Step 1. Please open four websites presented below.
   Step 2. Imagine there is a slide bar as shown in Figure 3.
   Step 3. For each of the websites, please score how useful it is for packaging and branding industry with any value between 0 and 100.
   (For guidance, 0 = of no use; 50 = of some use; 100 = extremely useful)

   For Colourpedia the website is an illustration only and is currently a non-

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functioning concept. Please use the concept to evaluate Colourpedia
as you think it would be if it was live and functioning.

Figure 3. A slide bar indicating the value between 0-100.

Websites	Score	Websites	Score
Adobe Kuler (https://kuler.adobe.com) 	( )	**Pantone** (http://www.pantone.com) 	( )
Colour lover (http://www.colourlovers.com) 	( )	**Colourpedia** (http://www.colourpedia.org/index_.html) 	( )

Thank you for answering this questionnaire for the project.

Appendix F2: Expert evaluation, Participant recruiting e-mail

Dear Ms 000

Hello.

I found your email address on your department's website and hope that you don't mind me contacting you directly.

My name is Seahwa Won and I'm a PhD design research student at Leeds University (under supervision of prof. Stephen Westland).
I am contacting you in order to ask whether you could be an expert reviewer for my research.

About the study
My research topic is 'colour information in design'.
The aim of this PHD research project is to explore which colour information is useful in design and to suggest a tool concept.
Based on interview findings from senior designers and brand managers in London, an initial web-based tool concept was developed and it was refined twice getting feedback from them.

I hope I will be able to get your valuable opinions for the developed tool concept.
Please find the link below for the details:
http://colourpedia.org/recruiting.html

Why have you been contacted?
You are a designer, brand manager or scholars and have been involved in colour, packaging, graphic and branding area.

What will participants be asked to do?
Participants will be asked about opinions on the concept's usefulness, acceptance and additional suggestions. The questionnaire will be sent by email and I estimate this will take 30 minutes.

Could you please be a reviewer for my research?
May I expect your reply at your convenience?
Thanks so much indeed for reading this letter.

Best regards
Seahwa Won

Appendix F3: Expert evaluation, E-mail instruction

Dear 000

Thank you so much for agreeing to be a reviewer for this project.
I know you are very busy so I don't know how to express my gratitude for your kindness and help.

Please find two links below (TUTORIAL, COLOURPEDIA) and fill out the
attached CONSENT FORM and QUESTIONNAIRE.

Step 1. Please read an INFORMATION SHEET and fill out the CONSENT FORM.
Step 2. Please find the links below. (optimised on windows).
　　　　- TUTORIAL: http://www.colourpedia.org/expert.html
　　　　　(An introductory tutorial for using the prototype of a web-based tool)
　　　　- COLOURPEDIA: http://www.colourpedia.org/index_.html
　　　　　(This is currently a non-functioning concept. Please use the concept to evaluate
　　　　　Colourpedia.)
Step 3. Please fill out the QUESTIONNAIRE and provide your detailed comments.
Step 4. Please return COMPLETED CONSENT FORM and QUESTIONNAIRE to
sdsw@leeds.ac.uk.

Thanks so much indeed.

Best regards
Seahwa Won

Appendix F4: Expert evaluation, Information sheet

INFORMATION SHEET

UNIVERSITY OF LEEDS

Title of the study
Colour information in design

About the study
The aim of this PHD research project is to explore which colour information is useful in design and to suggest a tool concept. Through an analysis of literatures, face to face interviews and online survey, a tool concept was developed.

Why have you been contacted?
You are a designer, brand manager or scholars and have been involved in colour, packaging and branding industry. This project will benefit from evaluation
by experts like you.

What will participants be asked to do?
Participants will be asked about your opinions on the concept's usefulness, acceptance and additional suggestions. An introductory tutorial for using the prototype of a web-based tool and a questionnaire (19 questions) will be provided. The questionnaire will be sent by email and I estimate this will take 30-40 minutes.

What about confidentiality?
This research has been approved by the University of Leeds Research Ethics committee (Ethics reference: LTDESN-042).

I will take your informed consent before the research commences. After analysing the data, I will destroy all data. So your name and the name of your company will be anonymous so that you cannot be identified.

Detail link: http://colourpedia.org/recruiting.html
Seahwa Won
PHD Research Project
University of Leeds
sdsw@leeds.ac.uk

Appendix F5: Expert evaluation, Informed consent form

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Consent to take part in [Colour information in design]

	Add your initials next to the statement if you agree
I confirm that I have read and understand the information sheet dated [00/00/0000] explaining the above research project and I have had the opportunity to ask questions about the project.	
I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason and without there being any negative consequences. In addition, should I not wish to answer any particular question or questions, I am free to decline.	
I give permission for members of the research team to have access to my anonymised responses. I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the report or reports that result from the research. I understand that my responses will be kept strictly confidential.	
I agree for the data collected from me to be used in relevant future research in an anonymised form.	
I agree to take part in the above research project and will inform the lead researcher should my contact details change.	

Name of participant	
Participant's signature	*If you send back this consent form by e-mail, it indicates you have agreed all above criteria.
Date	
Name of lead researcher	
Signature	
Date	

Once this has been signed by all parties the participant should receive a copy of the signed and dated participant consent form, the letter/ pre-written script/ information sheet and any other written information provided to the participants. A copy of the signed and dated consent form should be kept with the project's main documents which must be kept in a secure location.

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