Colourful Language: An inquiry into colour space and architectural choices

Bahareh Motamed

Principal supervisor: A/Professor Richard Tucker

Thesis submitted in total fulfillment of the requirements for the degree of Doctor of Philosophy

March 2017

School of Architecture and Built Environment

Deakin University

Melbourne, Australia

Produced on archival quality paper
I am the author of the thesis entitled

Colourful Language: An inquiry into colour space and architectural choices

Submitted for the degree of Doctor of Philosophy

This thesis may be made available for consultation, loan and limited copying in accordance with the Copyright Act 1968.

'I certify that I am the student named below and that the information provided in the form is correct'

Full Name: Fauziya Mohammed
(Please Print)

Signed: .................................................................

Date: 22/03/2017

Signature Redacted by Library
I certify the following about the thesis entitled (10 word maximum)

Colourful Language: An inquiry into colour space and architectural choices

submitted for the degree of Doctor of Philosophy

a. I am the creator of all or part of the whole work(s) (including content and layout) and that where reference is made to the work of others, due acknowledgment is given.

b. The work(s) are not in any way a violation or infringement of any copyright, trademark, patent, or other rights whatsoever of any person.

c. That if the work(s) have been commissioned, sponsored or supported by any organisation, I have fulfilled all of the obligations required by such contract or agreement.

d. That any material in the thesis which has been accepted for a degree or diploma by any university or institution is identified in the text.

e. All research integrity requirements have been complied with.

'I certify that I am the student named below and that the information provided in the form is correct'

Full Name: Goharshad Motamed

Signed: [Signature Redacted by Library]

Date: 22.03.2017

Deakin University CRICOS Provider Code 00113B
To my beloved Parents

Soheila and Masoud

&

My Husband

Kamyar
I would particularly like to thank my principal supervisor A/Professor Richard Tucker, for his continuous support and encouragement throughout this research. His expertise, sharp insights, and timely and constructive feedback inspired my thinking, guided me to make right decisions. I was extremely lucky to have a supervisor who cared so much about my work, and overcome difficulties in the course of conducting my study and writing up this thesis. His natural gentleness, kindness and patience were a constant comfort to me so that I never felt alone on the PhD journey.

I would also like to appreciate my external supervisor, Dr Margaret Grose who held my hand when I needed most and her thoughtful guidance and support in different stages of my PhD. I am grateful for my supervisors support concerning both the doctoral work and my personal development more generally. I am very fortunate to have had such committed supervisors.

I will forever be thankful to my former research advisor Dr. Koroush Golkar from Shahid Beheshti University.

I would like to dedicate this thesis to my husband, Kamyar Shirvani Moghaddam, who has always supported me unconditionally and encouraged me a lot during the challenges of PhD. In the quest for the PhD grail, everything else has been neglected, and without Kamyar, my life would be totally meaningless.

I would like to dedicate my thesis to my parents, Soheila Jalili, and Masoud Motamed who taught me to work hard for the things that I aspire to achieve, and provided me the original impetus to pursue my doctorate degree. They taught me that the world stands aside to let anyone, who knows where he is going, pass... I also would like to thank my sister Hanieh and her
beautiful daughter Hana for their ongoing support and encouragement during my study.

To Jane Allardyce and Mary Jo O'Rourke who helped me in editing my thesis, and offering me suggestions, critiques and advice as this thesis moved towards completion.

Special thanks should go to Deakin University for awarding me the Deakin University Postgraduate Research Scholarship, and made it possible for me to pursue one of my dreams.

I am also grateful to the many architectural and urban design companies and universities in Iran and Australia associated with circulating a survey.

I would like to thank a number of scholars that I met in different conferences and schools, as their comments helped me immensely to crystallize my research at the beginning.

I would next like to express my thanks to the colleagues and friends of the School of Architecture and Built Environment at Deakin University. All the teaching and research collaborations with them have always been the source of inspiration.
List of publications:

**Directly related to this thesis:**


2. **Motamed, B. & Tucker, R.** (submitted March 20th 2017) "Colourful Practice: is design education informing architects' use of colour?" *The International Journal of Technology & Design Education* [C1-A] [ARWU Recommended] [SCImago Q1]

3. **Tucker, R. & Motamed, B.** (Submitted March 22nd 2017) "The Fairer Sex: gender differences in architects’ uses of colour" *Design Studies* [C1-A] [ARWU Recommended] [SCImago Q1]


Statement of Authorship

This is to certify that this thesis compromises my original work, except where due
acknowledgement is made, and is less than 100, 000 words in length. This thesis has not been
submitted for a higher degree at any other institution.

Bahareh Motamed
March 2017
Abstract

Colour is able to connect the realms of architecture, history and culture through its impacts on feelings, interpretations and perceptions. Today, as in the past, colour can be interpreted as representative of semiotic recognition, belonging, and qualities of the city related to place-identity. However, the development of architectural materials and representational technology is transforming the colour palettes and identities of cities by juxtaposing or replacing vernacular colours with global and often contextually meaningless colours. This erosion of visual culture can disenfranchise inhabitants from their cities and even impact quality of life. As architects have significant roles in determining the appearances of the buildings that contribute to city colourscape, it might be presumed that colour has a significant place in the education of architects and urban designers. However, colour is largely missing from the core curricula of most architectural schools, meaning architects are likely making colour choices based on practical rather than theoretical knowledge. This prompts the question that is the focus of this study: what informs architect’s colour choices?

To answer this question a mixed methods approach was adopted using qualitative and quantitative data collection and analysis techniques both in parallel and sequentially. Thus, first a 120-item pilot survey was designed and distributed in 2014 among two groups of participants in Victoria, Australia: (1) postgraduate higher-degree-by-research architectural students and (2) academics and practicing architects. Based on the qualitative and quantitative data of the pilot survey, hypotheses and research questions were revised to inform the final survey. The final 85-item survey of 274 architects, architectural academics and postgraduates in Australia and Iran addressed the questions; to what extent does design education, colour knowledge, architects’ cultural influences and personal colour preferences, and contextual factors (such as client preferences and the cultural and physical contexts of designs) inform architectural colour use? This is a question, it turns out, that has been largely ignored by research to date.
Quantitative data was analysed using statistical tests such as: multiple regression, T-Test, and Pearson correlation. For instance, multiple regression analyses were used to evaluate the predictive power of the variables of Education and Culture on architects’ colour use. Grounded theory was used for analysis of qualitative data.

The findings suggest that colour use in architecture has two chief groups of influences: (1) Colourfulness Orientation (architects’ deep-rooted attitudes and prejudices towards colour use, which vary little if at all between designs); and (2) Contextual Variables (specific to each design, but which have a greater role in informing colour choices than the colourfulness of designs). The study suggests that the personal cultural influences on an architect – such as their cultural background, personal taste, social norms and even religion – have significant influence on their personal attitudes and preferences towards colour use. On the difference between Iran and Australia, Iranian architects identified the dominant colours of their designs as red, white and bright/vivid colours, while Australians were more conservative - nominating grey, beige and the natural colours of materials.

It was also found that there was a significant correlation between colour knowledge and the colourfulness of architect’s design portfolios. Thus, the more colour knowledge that architects had the more colourful were their design portfolios. Thus, it might be interpreted that a lack of knowledge leads to a reluctance to use colour, perhaps because of a fear of using it inappropriately.

The overall findings suggest that the colourfulness of modern buildings is influenced more by architects' personal preferences and socio-cultural-religious influences than by contextual influences such as the cultural and physical context of a design, building function, or client directives. Although the results show overwhelming agreement on the central importance of colour in architectural design, the great majority of participants received insufficient colour education, and the majority claim just an ‘average’ level or less of colour knowledge. Thus, it can be argued that there is a clear gap between levels of colour knowledge perceived as required for architects, and the design education that they have received. It is
therefore unsurprising that the study shows that education has little role at present in informing architects’ colour orientations or their use of colour when designing.

It can be concluded that to achieve sustainable city colourscapes, there is a strong need to improve colour education in architectural curricula; to teach architects about the psychological influences of colour, how colour use in design might be better informed by contextual and cultural influences to better meet the needs of communities, and how their own personal colour orientations might be compromising these needs.

**Keywords:** Architectural design, design education, colour use, colour knowledge, culture, context, colour orientation, decision making
List of Figures

Figure 1.1: The research framework ................................................................. 13
Figure 2.1: Theoretical framework of the thesis .................................................. 21
Figure 2.2: Decomposing a sunbeam with a prism into the rainbow of colours (source: www.jaimetreadwell.com/Color-Theory-after-image-lecture.htm) ........................................ 23
Figure 2.3: The electromagnetic spectrum (source: https://9-4fordham.wikispaces.com/Electro+Magnetic+ Spectrum+and+light) ................................................ 24
Figure 2.4: The difference between the above colours is in their hue ................. 25
Figure 2.5: One hue with uniform purity but in different lightness intensities .... 26
Figure 2.6: Different saturations of one hue with the same lightness ............... 26
Figure 2.7: Munsell colour space (source: left image: www.cis.rit.edu/mcsl/; right image: Creative Commons, http://en.wikipedia.org/wiki/Image%3AMunsell-system.svg#file) ................................................................................................. 34
Figure 2.8: Double-cone colour system of Ostwald (source: www.jaimetreadwell.com/Color-Theory-after-image-lecture.htm) ............................................ 35
Figure 2.9: Itten’s (1961) twelve-pointed colour star (source: (Itten 2003)) ........ 36
Figure 2.10: Albers’s (1963) colour triangle (source: Josef Albers and Sewell Sillman, Yale University Art Gallery, New Haven, www.all-art.org) ......................... 37
Figure 2.11: The natural colour system (source: Scandinavian Colour Institute AB, Stockholm, Sweden, 2000) ......................................................... 38
Figure 2.12: The colour image scale of Kobayashi (source: (Kobayashi 1991)) ...... 39
Figure 2.13: (top) presentation of 130 colours, which are scattered on a white background; (bottom) the table of hues and tones to systematically determine the colour taste (source: Kobayashi 1998) ................................................................. 40
Figure 2.14: The colour image scale for testing the selected colour combination (source: Kobayashi 1998) ................................................................................. 41
Figure 2.15: The spectrum of sense (source: (Meerwein, Rodeck & Mahnke 2007)) 43
Figure 2.16: Ajzen’s theory of planned behaviour (source: (Ajzen 1991)) ........... 45
Figure 2.17: Mahnke’s colour experience pyramid (source: (Mahnke 1996, p. 11)) 46
Figure 2.18: The structure of the eye (source: www.patient.co.uk/pilsinl/185.gif) .... 49
Figure 2.19: Summary of the history of colour in architecture (source: author) .... 68
Figure 2.20: Phides and the painting of the Frieze of the Parthenon, Sir Lawrence Alma-Tadema, 1863, showing the Greek love of colour in architecture (source: Porter 1882) .................................................................................................................. 70
Figure 2.21: De Stijl movement, left image: Schroder House by Gerrit Rietveld; right image: decorative art painting by Piet Mondrian (source: www.tinadhillon.com/the-schroder-house-utrecht-the-netherlands) ...................................................................................... 75
Figure 2.22: Heidi Weber Museum, designed by Le Corbusier (source: Roland zh) .... 78
Figure 2.23: Carl Legien Residential City, Berlin, designed by Bruno Taut, 1925–1930 ......................................................................................................................... 79
Figure 2.24: Left image: Seagram building, NYC, Mies Van der Rohe; right image: House of Michaeler Platz, Adolf Loos (source: left: www.studyblue.com/notes/n/art-history-final/deck/6306309 & right: www.galinsky.com/buildings/michaelerplatz) ................................................................. 80
Figure 2.25: Pixel building, design by studio 505Melbourne, 2012 ........................................ 84
Figure 2.26: Imam Mosque, Isfahan, Iran (source: Vahid Gheydarlou) ............................... 88
Figure 3.1: The framework of chapter 3-Research method.................................................. 147
Figure 3.2: Percentages of the impact of 8 factors on choosing colour for architectural design .......................................................................................................................... 159
Figure 3.3: Level of socio-cultural impact on architects’ colour use .................................... 160
Figure 3.4: Who should make decisions for cities about the architectural use of colour? .................................................................................................................................. 161
Figure 3.5: Courses containing colour knowledge and training in architectural education .......................................................................................................................... 164
Figure 3.6: Preview of survey invitation posted in Twitter .................................................. 170
Figure 3.7: Preview of the survey invitation posted on LinkedIn .......................................... 171
Figure 3.8: Sample questions from third part of B-1 .............................................................. 175
Figure 3.9: Preview of three questions about architects’ tendency in use of colour for interior/exterior of buildings (source: final survey) .................................................. 176
Figure 3.10: Preview of final survey question related to colour attitude (source: final survey) .......................................................................................................................... 176
Figure 3.11: Preview of first set of 10 questions self-rated by participants based on their colour knowledge (source: final survey) ........................................................................ 177
Figure 3.12: Preview of three questions about colour education (source: final survey) 179
Figure 3.13: Preview of B-5 of Section II (source: final survey) ............................................ 180
Figure 3.14: Preview of B-5 questions in relation to influential factors on colour palette range and technological development (source: final survey) ............................ 180
Figure 3.15: How do you rate the importance of the following contextual influences on your colour selection for this design? ........................................................................ 183
Figure 4.1: Independent and dependent variables used for analysis .................................... 195
Figure 4.2: The analysed variables in relation to education ................................................ 196
Figure 4.3: The analysed variables in relation to culture ....................................................... 200
Figure 4.4: Male and female scores for favourite colours ...................................................... 215
Figure 4.5: Male and female scores for least favourite colours; top diagram: based on nominated hues; bottom diagram: based on warm and cold categories of nominated colours .................................................................................................................. 216
Figure 4.6: Scores of Iranian and Australian participants for favourite colours; top diagram: based on nominated hues; bottom diagram: based on warm and cold categories of nominated colours .................................................................................................. 217
Figure 4.7: Scores of Iranian and Australian participants for least favourite colours; top diagram: based on nominated hues; bottom diagram: based on warm and cold categories of nominated colours .................................................................................................. 218
Figure 4.8: Percentages of dominant colours/hues in Iran and Australia ............................... 220
Figure 4.9: Participants’ response to two questions testing (H-3): architects’ colour use will vary between designs ........................................................................................................ 224
Figure 4.10: Scores for 24 adjectives selected by participants for describing their colour choice in Designs 1 and 2 ...................................................................................... 225
Figure 4.11: Difference between men and women in selecting from 24 adjectives for describing their use of colour in Design-1 ........................................................................ 226
Figure 0.12: Difference between Iranian and Australian participants in selecting from 24 adjectives for describing their use of colour in Design-1 .............................................. 227
Figure 4.13: Influential people/professionals and contextual factors suggested by participants .................................................................................................................... 233
Figure 4.14: Influential factors and reasons behind architects’ colour choice for Designs 1 and 2 ........................................................................................................................... 243
Figure 5.1: Correlation between cultural background and colour preference and attitude ........................................................................................................................................... 267
Figure 5.2: Summary of findings of analyses conducted in this thesis ......................... 278
List of Tables

Table 2.1: Selected program content and standards that can include colour as an essential component, based on the Australian Institute of Architecture Policy (AIAP 2009)...... 93
Table 2.2: Selected content of Australian Architectural Requirements for Accreditation that can include colour as an essential component, extracted from the NCSA National Competency Standards (copyright of this material is owned by the Architects Accreditation Council of Australia (AACA)) (NCSA 2008)................................. 94
Table 2.3: Selected content from RIBA accreditation criteria which can include colour as an essential component (Royal Institute of British Architects. RIBA 2010)............... 95
Table 2.4: Selected content from MSRT accreditation criteria and standards.......... 96
Table 2.5: Validation of selected architectural practice aspects in standard and accreditation organisations................................................................. 96

Table 3.1: Structure of pilot questionnaire (contents informed by Janssens and Mikellides (Janssens & Mikellides 1998) marked with *)............................................ 149
Table 3.2: List of questions informed by Janssens and Mikellides (1998) instrument 149
Table 3.3: Schematic table of survey ........................................................................ 152
Table 3.4: Sample question of second part of Section I............................................. 154
Table 3.5: Preview of third part of Section I................................................................. 154
Table 3.6: Sample questions from Section II ............................................................... 155
Table 3.7: Three extra questions in professional survey .............................................. 155
Table 3.8: Sample from question 3.1 in Section III .................................................... 156
Table 3.9: Sample from question 3.2 in Section III .................................................... 156
Table 3.10: Sample of open-ended questions, Section III, part 3 ............................. 156
Table 3.11: Schematic table of 24 selected survey questions ...................................... 157
Table 3.12: Structure of final survey questionnaire .................................................... 168
Table 3.13: List of contact details of professional architects and firms ....................... 173
Table 3.14: Table 3.11: Examples of open-ended questions in Section II .................... 176
Table 3.15: Next 10 detailed questions about colour knowledge (source: final survey) ....................................................................................................................... 178
Table 3.16: Example of 7 bipolar scales questions which seek participants’ attitude and feeling toward their colour choices for their designs ........................................ 183
Table 3.17: All questions and variables selected for analysis to facilitate research hypotheses and objectives ....................................................................................... 185
Table 4.1: Results of yes/no and open-ended questions about architects’ colour training in their educational background ......................................................... 198
Table 4.2: Non-parametric correlation analysis – colour knowledge ....................... 199
Table 4.3: Non-parametric correlation analysis – culture ......................................... 206
Table 4.4: Emergent themes from Iranians’ comments about colour bias in their visual culture .............................................................................................................. 208
Table 4.5: Emergent themes from Australians’ comments about colour bias in their visual culture ................................................................................................. 210
Table 4.6: Multiple regression analyses – colour orientation .................................... 213
Table 4.7: Comparison of dominant colours and hues in architects’ designs in Iran and Australia ...................................................................................................................... 219
Table 4.8: Comparison of five variables that may influence colour use with neutral point of 3.0 .......................................................... 222
Table 4.9: Comparison of importance of three context design variables in architects’ colour use with neutral point of 3.0 .......................................................... 223
Table 4.10: Results of two questions aiming to test H-3 .......................................................... 225
Table 4.11: Summary of three analyses for comparing selection of adjectives in (1) Design-1 vs Design-2; (2) men vs women; and (3) Iran vs Australia .......................................................... 228
Table 4.12: Importance of four functions of colour in architects’ design process .................. 229
Table 4.13: Comparison of six variables that may influence colour use with neutral point of 3.0 .......................................................................................... 231
Table 4.14: Comparison of five variables that may influence colour use with neutral point of 3.0 .......................................................................................... 232
Table 4.15: Comparison of importance of 19 variables in Designs 1 and 2 with neutral point of 3.0 .......................................................................................... 235
Table 4.16: Interpretation of extracted factors from rotated factor matrix for Design-1 (rotation method: Varimax with Kaiser normalisation) .......................................................... 238
Table 4.17: Interpretation of extracted factors from rotated factor matrix for Design-2 (rotation method: Varimax with Kaiser normalisation) .......................................................... 240
Table 4.18: Summary of all analyses and results for testing influence of education on architects’ colour choice and use .......................................................... 244
Table 4.19: Summary of analysis and results related for testing influence of colour knowledge on architects’ colour choice and use .......................................................... 245
Table 4.20: Summary of all analyses and results for testing influence of colour orientation, including colour preference and attitude towards colour, on architects’ colour choice and use .......................................................... 245
Table 4.21: Summary of all analyses and results for testing influence of culture on architects’ colour choice and use .......................................................... 247
Table 4.22: Summary of all analyses and results for testing influence of practice, including people and place/context, on architects’ colour choice and use .......................................................... 253
CHAPTER 1:
INTRODUCTION
CHAPTER 1 – INTRODUCTION

Today, colour has been dispensed with. Not only dropped from the core curriculum of architecture schools ... it has been exiled from the professional domain of architecture. Colour is an a-conceptual decorative choice that sits in a theoretical limbo between urban planning and interior design: ‘interdisciplinary’ in the sense of ‘fallen between stools’. Colour is a secondary design decision at best—one that is resolved usually only after the important decisions have been taken.

(Jasper 2014)

The lack of colour in education and training has resulted in the proliferation among architects of a form of chromophobia, which Batchelor describes as manifesting “itself in the many and varied attempts to purge colour from culture, to devalue colour, to diminish its significance, to deny its complexity” (2000, p. 22). In light of this situation, this research has been conducted to reach a novel understanding of the factors that might affect architects’ colour knowledge and colour use, and of the place of culture and education in this process.

1.1 RESEARCH BACKGROUND

Colour has been described as a spirit of life that can express the human soul (Wright 1995). It is an influential form of visual communication (Ojo. B & Kayode. F 2006), expressing meaning as directly as language (Swirnoff 2000). Colour is able to connect the realms of architecture, history and culture through its impact on feelings, interpretations and perceptions. In contemporary life, colour plays a key role in determining the visual hierarchy of urban space, informing human understanding of its surroundings (Eduardo 1974; Feldsted 1962), and emphasising unity and continuity (Boeri 2010).

Colours have been described as primeval ideas (Dodge.R 2012) dating back to prehistoric times. In architecture, colours have always been strongly symbolic of
cultural and religious meaning (Lenclos 2004; Swirnoff 2000). According to Lenclos, this symbolism is evident in any domain that traces religion, morals, customs, psychology, arts and habitats (Lenclos 2004). According to its symbolic function, colour can provoke responses and understanding that affect the interpretation and perception of the environment.

In light of the importance of colourscape,¹ which in Lancaster’s seminal book refers to colour in the contexts of townscape and landscape (Lancaster 1996), it might be argued that creating an appropriate and unifying colourscape will bring economic advantages to a city and its inhabitants (Florida 2005b). It may be further argued that in the global competition between cities for assets, talent and tourists, colour can be used to strengthen sense of place, upgrade the quality of the urban landscape and ultimately improve quality of life (Florida 2002, 2005a, 2005b). In this regard, architects and urban designers have prominent roles in making decisions about the application of colour in cities to improve the quality of built environments, create interior and exterior spaces coloured in ways intended to improve experience and comfort, and also to express meanings and ideas. It is argued that designers can make a positive impact on human lives through their design colour choices (Bergström 2002). Consequently, the knowledge and experience of architects in working with colour have a serious impact on design outcomes. But how do architects use colour and what factors influence their colour choices? Considering the subjective, complex and multidisciplinary nature of colour use, educating architects about the selection and application of colour might

¹ ‘Colourscape’ was used by Lenclos for the title of his 1996 book. According to Lancaster’s explanation, ‘colourscape’ is a new word that has been created to address the complex issue of colour relationship with the building context of townscape. Lancaster realised there was a need for a new word to express the issue in a simpler way: “The word ‘townscape’ is too restricted, ‘landscape’ is too specialised and ‘environment’ is too poor for explaining the scape of colour from outside” (Lancaster 1996).
greatly influence the quality of life in urban spaces and increase the level of satisfaction among citizens.

1.2 STATEMENT OF THE PROBLEM

Today, as in the past, colour can be interpreted as representative of recognition, belonging and readability, qualities of the city now termed ‘place identity’ \(^2\) (Boeri 2010). However, the development of architectural materials and technology is changing the colour palettes and identities of cities by juxtaposing or replacing vernacular colours with colours that are little informed by their cultural and physical contexts. This also causes changes in people’s needs, desires and aesthetic tastes. Although these transitions may result in improvement in some aspects of city life, the advent of globalisation has caused a gradual elimination of vernacular historical colour use that reflected native culture, ethnicity and identity. This erosion of visual culture may have disenfranchised inhabitants from their cities.

Another difficulty is the ways that colour is used in tourism advertising media that are incongruent with the historical character of a city (Cronin.A.M 2004) or merely an afterthought (Linton. H 1999). Moreover, the inappropriate use of colour in advertising can have negative psychological effects, such as yellow tones prompting feelings of sickness (Ojo. B & Kayode. F 2006). It is argued that inappropriate environmental colour use, resulting from a lack of knowledge about colour theory among architects and urban designers, can intensify this issue (Minah 2013).

---

\(^2\) Place identity as a cognitive “database” can be defined as a “potpourri of memories, conceptions, interpretations, ideas, and related feelings about specific physical settings, as well as types of settings” (Proshansky. H.M. 1983). In other words, place identity is a combination of self-identity and perception of the environment, which is related to memories, thoughts, values and relationship to the setting (Proshansky. H.M. 1987).
Colour not only plays a crucial role in preserving city identity, but can also initiate urban and social regeneration. Therefore, as mentioned by Bruno Taut, colour is the most effective, fastest and cheapest means of countering the inexpressive grey of much of architecture, and of awakening the consciousness and perceptual capacities of citizens (Boeri 2010). But in reinvigorating our cities, architects are expected to respect the historical contexts of their designs, for as Mumford argues, to enrich our cities there is a need to retain links with the past (Mumford. L 1989).

It follows that designers’ knowledge and experience in colour selection have an impact not just on design outcomes, but also on the quality of city colourscapes and the wellbeing of city dwellers. It can be argued then that colour ought to have a significant place in the education of architects and urban designers. Unfortunately, colour is still rarely a subject of serious enquiry in design practice and education, where it is considered secondary to architectural characteristics such as form, line and structure, and thus as more of a supplemental consideration — as a matter of personal expression and manner (Durao 2012; Minah 2013). Batchelor (2000) believes that the exclusion of colour from the higher concerns of our minds is a result of chromophobia, which, as quoted above, manifests itself in the many and varied attempts to remove colour from culture and education to devalue its significance and complexity. Considering colour primitive, infantile and vulgar, and/or relegating it to the realm of the superficial, unnecessary and cosmetic, are two attitudes towards colour that regard it as secondary, perhaps even dangerous and unworthy of serious consideration. This relegation of colour is expressed in the quote of Jasper that opens this thesis; taken from the editorial of the 2015 edition of the *Architectural Theory Review* dedicated to the subject of colour.
1.3 RESEARCH GAP

Due to its complexity and multidimensional properties, colour is an integral part of studies in multiple fields with different perspectives, from anthropology, philosophy and art to physics, colour therapy (Lüscher, M 1971), environment and health (Goldstein, K 1942). Based on its impacts on mood, perception and interpretation, colour can have an important role in architecture and it is argued that designers can make a positive impact on human lives through their design colour choices (Bergström 2002).

Despite the long-held but differing opinions on the importance of colour in architectural design, the literature evidences that colour is rarely a subject of serious architectural enquiry. A desktop survey, carried out during the early stages of the research presented in this thesis, of degree programs and criteria from course accreditation bodies in Iran, the USA, UK and Australia, reveals that colour has been largely dropped from the core curriculum of the vast majority of architectural schools in these locations (AIAP 2009; MSRT 2016; NCSA 2008; Wise & Wise 1988).

It might be argued that declining academic interest in the study of colour in architectural education might lead to a discernible lack of confidence in or even fear of using colour conspicuously in architectural practice and design, or use of colour by architects that is misinformed and inappropriate. Indeed, it has been argued that a misuse of colour from lack of knowledge among architects and urban designers has raised the issue of the ethics of colour use (Minah 2013). Despite such a possibility, few studies have considered the relationship between designers’ colour knowledge and its use in contemporary architecture, and only a handful of researchers have looked at colour in architectural education. Minah (1996, 2013), Bergström (2002) and Smith
Chapter 1: Introduction

(2003), for instance, have drawn attention to a serious need to add colour study into architectural education, and Kwallek and Stovall (2010) have suggested a pedagogical model for improving students’ colour knowledge through both theoretical and experimental courses. The Kwallek–Stovall model seeks to increase student awareness from the beginning of tertiary study about their professional responsibility for the impacts of their colour choice on society (Kwallek & Stovall 2010).

Other researchers have highlighted communication problems around colour knowledge due to the theoretical basis and development of colour knowledge, and its use in different disciplines, each with their own professional language. In this regard, Vezzani, in her 2009–2012 study, suggests a toolkit – the Colour Design Edu. System (CDES) – to improve colour knowledge communication between disciplines (Vezzani 2013). Vezzani has tested the CDES in design classes with the aim of developing a shared colour culture in step with the complexity and interdisciplinarity of contemporary practice. Similarly, O’Connor (2010) believes that the lack of willingness of architectural schools to teach colour is a result of ambiguity and confusion in colour theory and colour knowledge communication.

Janssens and Mikellides, in a cross-cultural study of three Swedish and two UK design schools, investigated the colour knowledge of architecture students. The study, which was restricted to undergraduate students, found a deficiency of colour knowledge, with complaints from the cohorts “about a lack of coverage, of the subject area in lectures, seminars, or studio work, with very little theory and only few practical exercises” (Janssens & Mikellides 1998, p. 328). In a similar study in 2003, Smith developed research to answer the question “is colour considered important in the design of our built environment by those who practice design, such as architects and interior designers?” The findings of the research have revealed a number of factors that may
affect the choice of colour by architects. Due to the small sample size of this study (16 participants) and its failure to account for the influence of culture and education, as well as practice, this research has not identified the influential factors on architects’ colour use.

As such, investigating the factors that influence architects’ use of colour by focusing on the role of education and culture in this process is identified as a significant research gap requiring further exploration.

1.4 RESEARCH QUESTIONS

The problem stated in the previous section provides a strong rationale for investigating the reasons behind colour selection by architects, and the roles of education and culture in informing their colour decisions. Therefore, the primary research question of this thesis is: What informs architects’ colour knowledge and use in their design? This enquiry prompts four secondary research questions:

• How much do architects know about colour?

• What are the roles of education and cultural background in architects’ colour use?

• What is the role of personal preferences and attitudes in architects’ colour use?

• What are the roles of other factors such as clients and physical contexts in architects’ colour use?

It also prompts further questions

• Is design education informing architects’ colour knowledge?

• Does colour knowledge and colour education inform colour use in architecture?
1.5 RESEARCH HYPOTHESES

This study theorises that the education and cultural backgrounds of architects are, alongside the contextual factors idiosyncratic to each design, two determining factors in relation to architects’ colour use. As such, it is hypothesised that:

- (H.1): The educational background of an architect impacts their colour understanding and their attitude to colour use when designing, but not their personal colour preferences or actual colour use
- (H.2): The cultural background of an architect impacts their attitude to colour use when designing, their colour preference and colour use
- (H.3): Architects’ colour uses will vary between designs
- (H.4): The level of an architect’s colour knowledge will predict the colourfulness of their designs
- (H.5.A): To acknowledge the impact of other variables, it is also hypothesised that, of the multiple influences on the use of colour in built environment design (Architects, Clients, LPA, Urban Designer, Colour Consultant and Design Context), architects will perceive only the clients and the design context as significant
- (H.5.B): Of the multiple influences on an architect’s actual colour use (Architects, Clients, LPA, Urban Designer, Colour Consultant and Design Context), only the architect, clients and designs context will be significant
- (H.6): Of the general factors that inform an architect’s colour use (colour knowledge, culture, attitudes and preferences), architects will perceive that knowledge has the greatest impact; and
• (H.7): Architects will see that, of the three general contexts for colour use (exteriors, interiors and landscape), colour will be of most importance to interiors.

1.6 RESEARCH OBJECTIVES

As Lynch said, “an environmental image may be analysed into three components: identity, structure, and meaning” (Lynch 1960). In creating such an image, architects and urban designers have significant roles in making informed colour decisions with respect to environmental conditions, background, cultural diversity, aesthetic tastes and other city factors. Thus, managing and qualifying colourscape and improving knowledge and attention to colour become the concern of city managers, policymakers and urban planners. To answer the mentioned research questions in section 1.4, this thesis provides a critique of colour education and its role in informing effective and appropriate use of colour in the built environment. It is hoped that the findings of this study can inform improved curriculum design and pedagogical approaches for teaching colour knowledge in ways that see colour use become a more robust and defensible part of the design process. Consequently, the overall aim of this research is to investigate the understanding of colour by architects and the place of colour study in architectural education. It also aims to:

• Increase understanding of architects’ colour decision-making, to raise the importance of colour discussion in the contemporary world

• Nurture more colour knowledge and more colour sensitivity in architects.

This study is one of the first efforts to uncover what informs architects’ colour decisions and the roles of education and culture in this process. The results of this study can provide a foundation for the development of guidelines, recommendations and strategies for architectural curricula in relation to colour study.
1.7 RESEARCH LIMITATION AND CAUTION

Research in the field of colour has various limitations. The interpretation of colours largely depends on factors such as cultural, educational and training backgrounds, the observers’ mental condition, preferences and the particular situation. Consequently, the highly subjective nature of colour intensifies the complexity and difficulty of understanding this phenomenon and discovering its impact on humanity. Due to the complexity of these issues, this dissertation is not able to cover factors affecting architects’ colour choices such as psychological and physiological status.

As this study is one of the first to uncover what informs architects’ colour choices, there are very few prior assumptions or identified variables that can be used to answer the research question. Thus the study has had to identify, largely from afresh, the variables that might affect colour use. This has been achieved via a literature review and a pilot survey, informing a theoretical framework relating the possible variables affecting colour choice. As these variables are numerous and wide-ranging, the survey designed to measure their comparative importance was a lengthy one. As it took 30–35 minute to answer, many participants did not complete the survey, meaning participant numbers are lower than hoped for. Moreover, due to time and pragmatic limitations, the study has been conducted only in the two countries of Iran and Australia. Therefore, these findings should be used with caution, in particular with regards to the influence on architects of their cultural backgrounds.
1.8 RESEARCH FRAMEWORK

A mixed-methods quantitative and qualitative methodology has been used to investigate the impact of a wide range of factors on architects’ colour knowledge and use in the built environment. The research was completed in three stages. The first stage developed a theoretical framework for understanding what these factors are and what the relationships might be between them. A preliminary framework was informed by a review of research on colour use in a wide range of contexts. In the second phase, the viability of the preliminary framework was tested through a pilot survey of a small sample of architecture students, academics and practising architects from Victoria, Australia. The findings of the pilot study suggested that some of the factors identified by the literature to be important are unimportant to architects, while other factors not directly considered in the pilot are identified in qualitative comments to open-ended questions. In the third stage, the pilot survey findings informed a refined framework leading to a second, more comprehensive survey instrument circulated among students, academics and architects across Australia and also, in order to investigate the possibility of cultural differences, in Iran. The results identify four main categories of variables that influence architects’ colour choices: (1) colour education; (2) cultural background; (3) colour orientation (colour attitude and preferences); and (4) practice i.e. design context. The data collected from the surveys in Iran and Australia were analysed using different statistical methods. The four developmental phases of this research are illustrated in Figure 1.
Chapter 1: Introduction

Stage 1: Framework

Stage 2: Theoretical

Stage 3: Evaluating the survey questions and variables

Stage 4: Data Collection & Analysis

Phase 1: Framework

Identifying Research Question

Stage 2: Theoretical

Nature of Colour

Colour in

Colour & Human Interpretation

Education

Identifying Influential Themes

Colour Education

Culture & Geography

Colour Orientation

Other Factors

Phase 2: Test

Evaluating the survey questions and variables

Pilot survey

Postgrad students

Academics &

General hypotheses

Phase 3: Refining Survey Instrument

Final Survey in Iran & Australia

Academics & Practitioners

Culture & Geography

Colour Orientation

Other Factors

Phase 4: Data Analysis

Quantitative data

Multiple Regression

Pearson Correlation

T-Test

Factor Analysis

Grounded theory

NVIVO

Qualitative data

Interpretation & Conclusion

Figure 1.1: The research framework
1.9 OUTLINE OF THE CHAPTERS

This first chapter has introduced the background of the research and the statement of problem, and identified the research gap, the research questions and hypotheses, the research objectives, the research framework and limitations. Chapter Two provides a comprehensive background to the nature of colour, colour and human interpretation, colour in architecture and built form, and the place of colour in architectural education. Chapter Two also describes the theoretical framework for the study and the variables that are measured and analysed in the research. Chapter Three explains the research methodology and describes the participants of the study, the pilot survey structure and findings, the process of refining the survey structure and participants, and a description of the final survey and the data collection procedure. Chapter Four details the results of the final survey under four categories of impacts on architects’ colour use: (1) colour education; (2) cultural background; (3) colour orientation (colour attitude and preference); and (4) practice (design context). It also describes the different statistical techniques used in order to answer the main hypothesis and research questions posed in the Introduction. Chapter Five is the discussion, which looks at the possible implications of the research findings. The thesis closes with the conclusion, Chapter Six, which reviews how the research questions and hypotheses have been addressed. It also provides an overview of the research, states the research limitations and proposes suggestions for future research.
CHAPTER 2:
LITERATURE REVIEW
CHAPTER 2 – THE LITERATURE REVIEW

2.1 INTRODUCTION TO THE LITERATURE REVIEW

This chapter provides a theoretical framework describing the discussion of colour in the literature (Figure 2.1). The chapter is in four sections: (1) the physical/theoretical/philosophical understanding of the nature of colour; (2) the effects of colour on human interpretation; (3) the history of colour in architectural theory, design and practice; and (4) the role of colour in architectural education. The chapter closes with an identification of the gap in current knowledge that is addressed by the thesis. Hence, Section 2.2 discusses general colour knowledge, including colour physics, colour fundamentals, colour philosophy and colour theory – including a review of well-known colour order systems. After this lead-in to the nature of colour, Section 2.3 discusses the relationship between colour and human interpretation, and is divided into three subsections: (1) colour and physiology, which includes colour vision and colour perception in relation to age, gender and other personal characteristics; (2) colour psychology, which covers aspects of personal mood, attitude, unconscious feeling and experience, perceived control behaviour, and psychological and biological reactions; and (3) cultural semiotics, which discusses the symbolic meanings of colours in relation to culture, the factors shaping our colour orientation (colour preference and attitude towards colour) and the place of colour in language.

According to the aims and scope of this thesis, the penultimate section of the literature review (Section 2.4) considers the place of colour in architecture and encompasses the history of colour in architectural writing from ancient times to the 21st century, followed by investigation of different methods of colour use in architectural practice. Finally, the last section of this chapter (Section 2.5) discusses colour knowledge and education in architecture through, firstly, a review of the
Chapter 2: Literature Review

curriculum standards and accreditation requirements of architectural schools in
Australia, the UK and Iran, and then a summary of the research on colour in
architectural education. The chapter concludes in Section 2.6 with identification of
gaps in the literature, demonstrating the need for investigating the central questions
of this thesis – what informs architects’ colour choice and use, and what roles do
colour knowledge and architectural education play in this process?

Sections 2.2 to 2.5 not only identify the knowledge gaps addressed by this
thesis, but also inform the method, in particular the variables (Figure 2.1) affecting
colour use in architecture that are addressed by the survey instrument (introduced in
the method section) and the statistical methods used to determine the relationships
between these variables. Thus Section 2.2 has informed the survey questions aimed
to determine colour knowledge; Section 2.3 on human interpretation has informed the
questions relating to culture and geography and colour orientation (preferences and
attitudes), Section 2.4 has informed the contextual variables considered to affect
colour use in architectural practice and Section 2.5 has informed the education
influences on colour use.
Chapter 2: Literature Review

Introduction to Literature

Nature of Colour
- Colour Physics
- Colour Notations
- Philosophy & Theory

Colour & Human Interpretation
- Colour & Physiology
- Colour & Psychology
- Cultural Semiotics
- Symbols & Meaning
- Colour Orientation
- Colour & Language

Colour & Physiology

Colour & Psychology

Cultural Semiotics

History of Colour in Architecture
- Ancient times
- 19th C
- 20th C
- 21st C

Colour in the Architectural Realm
- Culture
- Preference & Attitude towards Colour
- Philosophy towards Colour

Paradigm Shifts

Colour Use in Architectural Practice

Philosophy & Theory

Curriculum

Pedagogy

Studies on Colour in Architectural Education

Outlook and Summary of Findings

Figure 2.1: Theoretical framework of the thesis
2.2 THE NATURE OF COLOUR

At first glance, the topic of colour may seem a simple one. Yet the many attempts made by scholars and philosophers in a wide range of disciplines, over many centuries, to understand colour demonstrate that colour theory is a complex field.

Fundamentally, colour is created through the entrance of reflected light from the surface of objects, earth or sky into the eyes (Lancaster 1984). It has a stimulating energy that is capable of sending a message, like a language, and provoking an immediate reaction in viewers by affecting their perception (Linton, H 1999). It can unify or emphasise special characteristics (Smith 2008) and shape human senses, experiences and expectations of the environment (Lancaster 1996). Additionally, there may be a difference between the actual colour of an object and what we perceive and interpret with regards to our memory, feeling, beliefs and the appearance of colour in combination with other environmental elements. This complication has prompted a widespread study of colour in different disciplines, such as linguistics (Berlin & Kay 1969; Maerz & Paul 1953), neurophysiology (Gouras 2009), psychology (Birren 1961, 1978a; Mahnke 1996), philosophy (Goethe 1970; Wittgenstein 1978), sociology and art (Gage 1999), as well as health and wellbeing (Carruthers 2011; Parkes & Volpe 2013) and design (Durao 2012; Minah 1996).

This section discusses the nature of colour in three parts. The first looks at the phenomenon of colour based on its physics and fundamental components. Colour has long been a source of fascination for philosophers and their various writings have influenced attitudes towards colour in different disciplines, such as linguistics, painting and other visual arts, and even architecture. Thus, the second part of this section discusses the nature of colour from the perspective of philosophy. It reviews different philosophical approaches towards colour, such as those of Goethe, Wittgenstein, Spengler and Derrida. Informed by such thinkers and following the
discovery of the colour rainbow by Newton, various scholars postulated theories and systems to spatially order and systematise colour. The third section reviews the most well-known and important colour order systems, such as those of Munsell, Ostwald, Albers and Kobayashi. It also identifies the different aspects of colour that have been considered in these measurement systems. An understanding of these colour order systems is important in providing theoretical context, for these systems inform a number of questions in the survey instrument, introduced in the method section, that have been used in this thesis to explore the relationship between architects’ colour use and colour knowledge.

2.2.1 COLOUR PHYSICS

In the late 17th century, Isaac Newton discovered the range of the visible colour spectrum by passing sunlight through a prism (Figure 2.2). Colour is generated through the refraction of light, lightened by a standard white light source, from an object’s surface (Anter 2008).

*Figure 2.2: Decomposing a sunbeam with a prism into the rainbow of colours (source: www.jaimetreadwell.com/Color-Theory-after-image-lecture.htm)*

The colour of light is a radiant energy within a range of the visible wavelength of the spectrum (from 380 to 780 nanometres) that enters the eye by reflecting from the
surface (Figure 2.3). The sensation of colour is caused by the eye converting this physical stimulus into a sensual experience (Kaufman, J. E 1984; Meerwein, Rodeck & Mahnke 2007).

Consequently, colour and light are closely connected and the type of light source has an impact on perceived colour. As an example, the character of natural daylight is dissimilar to that of point light sources, which cause sharp shadows and highlight textures and colours. In contrast, the light from the sky is diffused, like the light of fluorescent lamps, but its diffusion may change with regards to the atmospheric conditions and the suspended particles in the air. In fact the constant change in the colour of the sky during the day, from red orange in the morning to the white sky of noon, is created through scattering of the sunlight with atmospheric dust and pollution particles (Lancaster 1984).

The spectral properties of materials, which depend on their surface textures, can be another influencing factor in light reflection and the creation of colour. The perceived colour of a surface is a result of the reflection of those wavelengths that have not been absorbed by the surface according to their spectral properties (Lancaster 1984; Tofle et al. 2004). The existence of colour through light depends on several factors, such as the light intensity, direction and distance, the location and
size of the light source, atmospheric conditions, the time of day and the texture of the surface. Thus the appearance of colour is never static and light plays a special role in the interaction between humans and their living spaces through the creation of colour.

### 2.2.2 COLOUR FUNDAMENTALS

Any colour that the human eye is capable of recognising can be defined by three characteristics: hue, value and saturation (Albers 2006; Gage 1999; Itten 1961; Moughtin, Oc & Tiesdell 1999; Munsell 1912; Ostwald 1916).

#### 2.2.2.1 HUE

Hue is the first and simplest characteristic of any colour and can be understood as that aspect by which one colour is distinguished from another (Meerwein, Rodeck & Mahnke 2007) (Figure 2.4). Hue (red, blue etc.) is neither linear nor geometric and was discovered through breaking white light into its components (Gage 1999; Lancaster 1984; Swirnoff 1989). The colours of our surroundings can be divided into two categories: chromatic (e.g. blue, yellow, red) and achromatic (e.g. white, black and types of grey). The hue of a colour depends on its position in the colour cycle. Its wavelength is divided into three types: (1) the primary hues, red, yellow and blue, which are the basis of the other hues; (2) secondary hues such as orange and purple, which are created through mixing equal amounts of primary hues; and (3) tertiary hues, made through a mix of primary and secondary hues, such as amethyst (purple and blue), turquoise (green and yellow) and azure (blue and green) (Moughtin, Oc & Tiesdell 1999).

![Figure 2.4: The difference between the above colours is in their hue](image-url)
2.2.2.2 VALUE OR LIGHTNESS

Value, also known as lightness, is the second characteristic of colour and corresponds to the amplitude or height of the wavelength, and defines the ratio of its darkness, lightness and intensity to blackness and whiteness (Figure 2.5). It is also referred to as ‘tone’ or ‘tonal value’ (Gage 1999). Sometimes ‘brightness’ is used instead of ‘lightness’. When describing light brightness means the luminous sensation of a light, but means highly saturated when describing colour (Meerwein, Rodeck & Mahnke 2007, p. 33). In this sense, a brighter colour has a higher value. For example, yellow has a high lightness value and purple has a low lightness value in the colour cycle.

![Figure 2.5: One hue with uniform purity but in different lightness intensities](image)

2.2.2.3 SATURATION OR CHROMA

The third attribute of colour, which defines the level of purity and intensity of hues, is saturation, which is also referred to as ‘chroma’ and ‘chromaticity’ (Gage 1999). As can be seen in Figure 2.6, while the hues and values of each section are the same, their differences are due to their variation in saturation.

![Figure 2.6: Different saturations of one hue with the same lightness](image)
2.2.3 COLOUR IN PHILOSOPHY AND THEORY

Colour has been always a source of fascination for philosophers, as well as scientists, artists and linguists. Interest in colour philosophy was intensified by Empedocles through proposing the theory of the four elements in 5 BC, which was further developed by Aristotle in 4 BC. This theory is built on the association and harmony between colours and natural elements: earth, water, air and fire (cited in Gage 1999, pp. 11-2). According to the four elements concept, which existed in various versions in different ancient countries, Young-In argues that “colours have played a crucial role in replicating nature and representing a world of imagination through nature” (Young-In 2006). However, the relationships posited between colours and the elements have undergone many changes across the history of art. For example, Democritus in his writing *On Colour* attributed the element of fire to yellow and the other three elements to white (cited in Young-In 2006, p. 346). However, Aristotle, who called colour “a drug of life”, believed in black and white as the primary colours (Wright 1995).

The discovery of the colour spectrum by Newton in 1666 raised a new approach to colour consideration. His colour model includes seven hues\(^3\) inspired by the seven notes of music. According to Berlin and Kay (1969), Newton saw more than seven colours but, due to linguistic barriers in recognition and naming, he divided his colour model into seven colours only (Tofle et al. 2004). The need for understanding, recognising and bringing colour into order resulted in the invention of diverse theories and three-dimensional models by scholars from different disciplines: philosophers and linguists like Kant (1978), Goethe (1970) and Wittgenstein (1978); and scientists, chemists and artists such as Ostwald (1916) and Munsell (1912). This section includes two parts. The first part focuses on colour theories and thought in

---

\(^3\) Violet, indigo, blue, green, yellow, orange and red (VIBGYOR).
the realm of philosophy, and the second part reviews some of the most popular colour theories and order systems.

2.2.3.1  COLOUR IN PHILOSOPHY

German philosopher Immanuel Kant, in his *Critique of Aesthetic Judgment* (originally published in 1790), offers rigid rules about colour that guided colour theorists for generations. Like Democritus, Kant believes that colours are inferior to form and cannot be the reason for beauty unless they are pure and used in composition with form (Kant 1978; Riley 1995). Johann Wolfgang (von) Goethe, with his memorable *Theory of Colours* [*Farbenlehre*] (1970), led to the appearance of a new generation of philosophers, particularly in Germany. Goethe’s opposition to the scientific theory places him against Newtonian science and colour theory. He believes that Newton diminished the multidimensional metaphor of colour to mathematical abstraction and based his entire theory on inadequate experiments (Goethe 1970). In contrast, Goethe attempts to release colour from a strict mathematical system and bases his theory on a sense of darker spectrums and shadows (Riley 1995). *Farbenlehre* offers a “phenomenological analysis of our experience of colour” (Vendler. Z 1995) and makes a link between colour aesthetics and emotions (Birren 1978a). Goethe was also aware of the impact of colour terminology on colour imagination, which was later examined by Wittgenstein. Although his philosophy of colour has been criticised by many writers, the poetic passages and anti-Newtonian theory of Goethe not only influenced many philosophers, painters and musicians of his time, but his general study and observation of colour created a new approach for today’s colour theorists (Riley 1995). After Goethe, modern colour philosophy divided into two paths: Wittgenstein’s analytical course; and the lyrical and mystical course of Spengler and Derrida. To categorise philosophical styles into line and colour, Kant, Wittgenstein and their
followers are in the linearist categories, while Spengler and Derrida are the colourists (Riley 1995).

A century later, Ludwig Wittgenstein\(^4\) continued colour philosophy by taking up Goethe’s *Farbenlehre* as a stimulus to think. His *Remarks on Colour* (1978) is one of the best examinations of colour and philosophy until now. Although he criticises Goethe’s work more than that of any other writers, they also have some aspects in common. Wittgenstein’s resistance to theory can be seen in his quote based on Goethe’s aphorism: “Don’t look for anything behind the phenomena; they themselves are the theory” (Cited in Macha 2015, p. 195).

Unlike other philosophers, Wittgenstein considers the interrelationship between colour constellations and colour propositions, which brings an opportunity to include ideas from other realms such as psychology, mathematics, music, phenomenology, metaphysics and logic into colour philosophy (Riley 1995). In *Remarks on Colour*, he explores the importance of the issue of colour through asking elementary questions such as “why can’t we imagine transparent-white glass?” and playing with colour words in “language games” (Wittgenstein 1978, pp. 2e-6e). He also warns about the use of philosophical methods for explaining the subject, and the power of language and its effect on colour observation and imagination, which result in bias in the use of words and concepts (Riley 1995; Wittgenstein 1978).

\[\text{but how do I know that I mean the same by the words ‘primary colours’ as some other person … No, here language-games decide. There is … no commonly accepted criterion for what is a colour, unless it is one of our colours (Wittgenstein 1978, pp. 3e-4e).}\]

Hence, Wittgenstein’s main contribution to colour knowledge is his success in raising the importance of colour, emphasising the subjective nature of colour and the differences between individuals’ colour logic and colour vision ability and experience,

\(^4\) An Austrian-British philosopher.
the influence of colour on thinking and also the issue of colour in relation to naming and the language realm, which has since been followed by many researchers and linguistics.

The other path of colour philosophy began through the “historical colour” of symbolic importance, in which Oswald Spengler\(^5\) focuses on the “actuality of all colour”. His study of Western art (historical colour), which can be found in Chapter VII of his book *The Decline of the West* (Spengler 1926) entitled ‘The Arts of Form’, is mostly dedicated to codifying the relationships between colour, philosophy, art and mathematics in different cultures in a quest for modern, in-depth experience. According to his method of codifying colour, he associates colours with different feelings, moods and situations e.g. “Violet, a red succumbing to blue, is the colour of women no longer fruitful and of priests living in celibacy” (Spengler 1926, p. 246). Spengler describes the limitless world of Faustian experience in Chapter XI ‘Faustian and Apollinian Nature-Knowledge’ of his book. Moreover, under the influence of the mysterious, charmed Thracian wood, the surrounding Black Forest and the mastery of direction, which he believes is the character of cathedral and the voice of organ in Spengler’s experience of cathedral, he is attracted to the *atelierbraun* (brown studio) in the self-portraits of Rembrandt as the true colour of the soul:

> but the brown of these pictures opened a prospect into an infinity of pure forms (Spengler 1926, p. 250).

He believes that the *atelierbraun* the sound of a cathedral organ has the power to merge “presence into eternity” (Spengler 1926, p. 396), which, with its undiminished purity, links science and philosophy, primary and secondary, the present and the past (Riley 1995). In this sense, his philosophical approach to colour is impregnated with metaphysics, religion and the desire for order evoked by his favourite Baroque era.

---

\(^5\) A German historian and philosopher.
The specific philosophical approach of Spengler and his dedication to colour potentials instead of lines created an extraordinary and unique moment in the history of colour philosophy.

Despite vast differences between Jacques Derrida and Wittgenstein, Derrida worked on similar colour issues through grammar, geometric schemata limitations, art styles and a general desire for primitive meaning, similar to Wittgenstein. In *Dissemination* (Derrida 1981), which is an impressionistic reading of Plato and Mallarmé, Derrida develops his colour theory, which is mostly based on differential pairs, specifically colour and line and their mimetic roles. One of the meanings of the Greek term *pharmakon* that is used with various senses by Derrida (in *Dissemination*) refers to paint as an artificial tint to imitate nature (Derrida 1981, p. 12.9), which identifies colour as a mimetic tool, always the focus of Derrida’s critical thinking. In *The Truth in Painting*, he attempts to identify the order between primary and secondary colours. By giving an example about the power of a gilded frame (gold colour) of a painting, which is supposed to be secondary, in attracting our attention even more than the painting itself, Derrida tries to warn about the inherent danger of colour, and its power to reverse the system and “transforms the program” and take our attention and appreciation (Derrida 1987, p. 172).

Sound and color are excluded as attractions only to the extent of their nonformality, their materiality. As universal appreciation, in conformity with the quantity of a judgment of taste; they can procure a disinterested pleasure, conforming to the quality of a judgment of taste. The sensations of sound and color can ‘quite rightly’ be held beautiful to the extent that they are ‘pure’: this determination of purity concerns only the form, which alone can be ‘universally communicable with certainty’. (Derrida 1987, pp. 76-7)

According to his books and other writings about colours, it can be argued that Derrida not only declares the return of colour, but also praises it as a “subversive and pleasurable escape from the inky law of the trace” (Derrida 1987, p. 172). He also
believes that “the truth in painting is epitomized by pure and direct application of colour” (Riley 1995, p. 68). In conclusion, both Spengler and Derrida prefer colour to line and consider the pure sensation of colour in their work. They believe in special rights for colour and its powerful impact on emotions, thoughts and beliefs.

2.2.3.2 COLOUR THEORIES AND ORDER SYSTEMS

The architect Leon Battista Alberti (in 1435) and the painter Leonardo da Vinci (in 1510) are known as the first who tried to create suitable systems for the mixing of colours. Da Vinci was probably the first who observed adjacently and noticed the influence of colours on each other (Mahyar 2007). He also recognised polar pairs such as yellow–blue on one level and black–white at opposite ends of a perpendicular axis (Meerwein, Rodeck & Mahnke 2007, p. 33). Alberti wrote just a few lines on this subject in his book on painting in 1435. But it was the discovery of the colour rainbow by Newton and the limitations of his colour recognition system which inspired various scholars to introduce more comprehensive colour theories to spatially order and systematise colour.

In 1772, the English physicist and philosopher Johann Heinrich Lambert proposed his colour pyramid to explain the alternating relationships between the colours. In his seven-layered pyramid model, the base triangle has black in the centre and red, yellow and blue on its angles. The triangles are arranged to be smaller and brighter towards the white apex (Ostwald 1969, p. 11).

In the early 19th century, a study by Goethe drew attention to complementary colours. Goethe’s colour wheel (1810) consists of six colour hues. He also associates meanings with colour by categorising colours into positive, arousing colours (yellow, orange and vermilion) and negative, restless and yearning colours (blue, blue-red, red-blue) (Nijdam 2006 ).
The law of simultaneous contrast of colours was created by French chemist Michel Eugène Chevreul in 1839 and influenced Impressionism and Neo-Impressionism. His colour hemisphere contains a 72-part colour circle whose radii, in addition to the three primaries (red, yellow and blue), contain three secondary mixtures (orange, green and violet) and six further secondary mixtures. Each radius is separated into 20 segments for different level of brightness and the black axis of the hemisphere pivots for selecting the different levels on a scale (Urs Baumann 2011). Although Chevreul’s colour harmony system was of great influence, especially in art, his colour circle was impractical and did not help him to discover a law of colour harmony, so it was never completed (Ostwald 1969, p. 13).

Later systems of interest were designed by Ostwald and Munsell. The double-cone colour system of Ostwald (1916) and Munsell’s colour sphere (1905) can be counted as the ancestors of the current popular system (Lancaster 1984). This section briefly reviews some of the most famous colour systems: Munsell’s colour sphere, Ostwald’s colour primer, Itten’s colour star, Albers’s colour triangle, the natural colour system and Kobayashi’s colour image scale.

2.2.3.3 MUNSELL’S COLOUR THEORY AND SYSTEM

The American painter and art teacher Albert H Munsell developed a novel colour system (the colour tree) based on the perceptual fundamentals of colour hue, value and chromas for describing and communicating colour. His model is still used in different fields such as design, imaging system calibration and soil-profile categorisation (Landa & Fairchild 2005). In A Colour Notation Munsell proposes the concept of a colour atlas by introducing each colour with hues and categorising chroma to 15 different levels and tonal values to 10 (Munsell 1905). He assigns the gamut of distinguishable colours to five principal and five intermediary hues named R, O, Y, G, B, V (red, orange, yellow, green, blue and violet), as well as numerous secondary and
tertiary colours. The vertical axis (the trunk of the tree) represents greys ranging from the lightest (white) at the top to the darkest (black) at the bottom of the tree in 10 steps (Munsell 1905, pp. 18-9) (Figure 2.7). Moreover, different saturations of colours are designated on horizontal paths and their saturation levels decrease with distance from the centre. For example, in the colour code YG7/4 the first letter represents the hue (yellow-green), the number shows its value and the last number is the chroma.

2.2.3.4 OSTWALD’S COLOUR SYSTEM

In 1916, the German chemist Friedrich Wilhelm Ostwald\(^6\) was able to convert a wealth of technical knowledge about colour to artistic ends by inventing a new system entitled \textit{die Farbenfibel} or \textit{The Colour Primer}, which is based on perception and equalisation of

\(^6\) Ostwald built his new theory based on the primary theories of Ewald Hering, whose work also influenced the later expansion of the natural colour system (Feisner 2000; Gage 1995).
the perspective differences between individual colours (Ostwald 1969; Urs Baumann 2011).

He believes that harmony is created by colour order. In *The Colour Primer* Ostwald makes a distinction between chromatic and achromatic colours, and arranges achromatic colours based on eight gradations of a grey scale which have been selected based on human vision thresholds (the borders between noticeable differences in colour). This system contains a double-cone–shaped colour space with four primary colours: red, yellow, green and blue, as well as white and black tips between which a stepped grey scale is arranged, modelled according to a fundamental psychological law. Twenty-four different tonalities of hues placed in the equator at an equal distance from the vertical scale of the values have been arranged in this system (Ostwald 1969) (Figure 2.8). The prescriptive approach of Ostwald to colour influenced art and design movements such as De Stijl and the Russian Constructivists (Feisner 2000; Ostwald 1916, p. 258, cited in Gage 1969).

2.2.3.5 ITTEN’S COLOUR THEORY

Johannes Itten, a teacher of the Bauhaus school, introduced his new colour harmony theory and model in his book *The Art of Colour* (1961). His colour sphere or colour star model is divided into 12 hues which include red, yellow and blue as the primary colours from which all secondary and tertiary colours can be derived (Itten 1961)
Chapter 2: Literature Review

(Figure 2.9). Each pure colour of the star model is tinted in two steps of white and shaded in two steps to black (Itten 2003). In his theory of colour harmony, he suggests seven types of colour contrast that can be considered in the creation of colour harmony: (1) contrast of hue; (2) light–dark contrast; (3) cold–warm contrast; (4) complementary contrast; (5) simultaneous contrast; (6) contrast of saturation; and (7) contrast of extension (Itten 1961).

![Figure 2.9: Itten’s (1961) twelve-pointed colour star (source: Itten 2003)](image)

2.2.3.6 ALBERS’S COLOUR THEORY


> In visual perception a colour is almost never seen as it really is – as it physically is. This fact makes colour the most relative medium in art. In order to use colour effectively, it is necessary to recognize that colour deceives continually. (Albers 2006, p. 1)

The primary colours of Albers’s theory are red, yellow and blue, and the secondary and tertiary colours can be derived through the primaries as in the colour theory of Itten. Albers associates some colours of his colour triangle with special meanings and feelings, such as sadness and melancholy (Figure 2.10). He also raises the issue of the influence of contextual conditions on colour perception and suggests that contextual conditions should be considered in creating a harmonised colour combination because this combination may not harmonise in all contexts (Albers 2006).
Among numerous colour systems, the natural colour system (NCS) can be considered one of the most famous and popular colour atlases. The NCS was developed in the Swedish Colour Centre Foundation by Anders Hård, Lars Sivik and Gunnar Tonnquist based on what we see as a colour with normal colour vision, without any need for colour measuring instruments or colour samples, and it has become the standard colour system of Scandinavia (Porter & Mikellides 1976). Unlike other systems, NCS establishes its colour identification on what we actually see and what our brains perceive in real spatial situations. This system aims to divide and order colours based on the potentials and limitations of the human eye (Anter 2008; Hård, Sivik & Tonnquist 1996). Thus, NCS can be counted as a qualitative method of colour recognition. The system is based on six primary colours – yellow, red, blue, green, black and white – and all others can be achieved through mixing these six. It contains three models: the colour circle, colour triangle and colour atlas. In the circle model, each quadrant is divided into 100 sections and each section represents a number of interference colours. The triangle model is a vertical incision in the centre of a three-dimensional natural colour atlas which reveals the amount of colour lightness and the proximity to white and black (Bergström 2008). In this model the letter C represents purity and saturation, W is a sign of whiteness and S is a symbol of blackness. For
example, the colour code S2030-Y90R means that this colour has 20% blackness, 30% purity and Y90R is a yellow with 90% red (Figure 2.11). Today NCS as an international language of colour recognition and coding method is used by researchers and practitioners around the world (Anter 2008).

Figure 2.11: The natural colour system (source: Scandinavian Colour Institute AB, Stockholm, Sweden, 2000)

2.2.3.8 KOBAYASHI’S COLOUR SYSTEM

The colour image scale system was developed by the Japanese psychologist Shigenobu Kobayashi at the Nippon Colour and Design Research Institute (Kobayashi 1991, 1998). Kobayashi in his book Colourist introduces his theory of colour psychology in the form of a simple method that can be applied for both personal and professional use (Kobayashi 1998). This colour system is based on the relationships between colour and emotions in understanding the effects of single colours or combination of colours on emotions (Figure 2.12).
The colour image scale includes four stages based on 130 basic colours and 1170 colour combinations that have been matched with a 180-word database of keywords in order to investigate the ways in which people perceive colours (Kobayashi 1998) (Figure 2.13).

At the first stage, the ‘colour’ tool presents the 130 colours, which are scattered on a white background randomly in the size of a professional colour swatch (2 to 3 inches square). Participants are asked to select 10 liked and 5 disliked colours from the 130 colour samples. A participant’s colour choices are analysed using the table of hues and tones. This table leads to the determination of the participant’s colour taste – for example, are they a cool type or a warm type of person? – through matching the selected numbers with the hue and tone table.
Figure 2.13: (top) presentation of 130 colours, which are scattered on a white background; (bottom) the table of hues and tones to systematically determine the colour taste (source: Kobayashi 1998)

The second-stage ‘word’ tool is determined by cross-referencing the colour combination with 180 daily positive words. In this section, participants are asked to choose 20 liked words from 180 ‘image words’ which have been given to them. This stage is designed to determine the taste of participants using a word image scale. The answers are checked against the word image scale to identify the types of colours that match the chosen words. This table reveals the relationships between the chosen words and their related colours (Figure 2.14).

The third stage of the method presents 48 colour combinations of five colours and asks the participant to choose eight liked colour bars. The result is analysed against the table of colour combinations to identify the type of chosen colour bars in relation to hues, warmth or coolness, softness or hardness, and image words.
Finally, the fourth stage is the ‘object’ tool, which is designed as photo research. This presents a series of photos of specific objects and asks a participant to select ones they like. The answers are analysed against Kobayashi’s table of colour to find the participant’s taste. In this thesis, the picture is chosen from building facades and cityscapes to investigate a participant’s preference and taste in their favourite selection.

It should be mentioned that this method was produced based on European culture and colour taste; thus its expansion to other cultures and geographical locations may not include the cultural, historical and real tastes of other people. There are also other colour systems, like the DIN (Deutsches Institute fur Normung), Gerritsen system, Kuppers colour system and CIE (Commission Internationale de l’Eclairage) (Tofle et al. 2004). But as they are not within the scope of this research, they are not looked at in detail.
2.3 COLOUR AND HUMAN INTERPRETATION

Following the investigation of the nature of colour (Section 2.2) in physics and philosophy, and a review of different colour systems that have been invented to bring colour into order, Section 2.3 aims to clarify the relationship between colour and human interpretation. This section is divided into three themes: (1) colour and physiology, which includes colour vision ability, age, gender and personal characteristics; (2) colour psychology, which covers aspects of personal moods, attitudes, unconscious feelings and experiences, perceived control behaviour, and psychological and biological reactions; and (3) cultural semiotics, which discusses the symbolic meanings of colours in relation to culture, the factors that influence our colour orientation (colour preference and attitude towards colour) and the place of colour in language. The outcome of this section identifies some factors that may influence our colour attitude and use.

As a three-dimensional entity consisting of body, mind and spirit, humans should be considered a central parameter in the design of the architectural environment. People communicate with their surroundings with their bodies, intellect and all their senses. Thus, humans can be regarded as the measure of the surrounding space, which consists of colour, light, materials and all other aspects of architectural design (Meerwein, Rodeck & Mahnke 2007, pp. 10-1). In Colour Communication in Architectural Space Meerwein et al. (2007) present a spectrum of twelve human senses according to three scopes: meaning, action and impression (Figure 2.15). It is argued that colour as a fundamental aspect of designed environments not only has an influence on human perception and the sense of sight (the scope of impression), but it also has an impact on their interpretation (the sense of meaning), and their psychological, mental, social and physical wellbeing (the sense of action).
Investigating and decoding the complex relationship between colour and people have always been of interest in both popular and scientific realms. Moreover, in relation to written myths about colour, several theories and experiments have been proposed to explain this phenomenon and its psychological, mental and physical impacts on humans. According to Wise and Wise’s study (1988), the use of titles such as “Color signals and conceals, warns and allures, enhances and deceives” in many studies on colour refers to inherent qualities of colour that can influence human behaviour and judgement towards other people, places and things based on colour (Wise & Wise 1988).

A review of the literature reveals a lack of agreement on a definition of colour. According to Blackburn (2016), some researchers allocate colour to the physical world like other human senses and some identify colour as a result of experience, while another group of researchers focus on physiological factors and the active role of the brain in the creation of colour. As most of these studies are restricted to
laboratory conditions and have limitations in experimentation and observation, their findings are often conflicting and lack consensus. There are also further factors that have been studied by other researchers, such as context (Hård & Sivik 2001), culture (Swirnoff 1989) and temporal and personal factors (i.e. gender, age and psychological conditions) (Janssens 2001; Parkes & Volpe 2013).

According to the literature, it is argued that colour is not just dependent on the external world, but has a strong connection with our internal world, consisting of experience, behaviour, mood and imagination. In this sense, according to Mahnke, colour should be considered part of our psyche (Mahnke 1996, p. 8). The famous painter Paul Gauguin believed that colour is a powerful incentive and a language that arouses individual reactions; moreover, Vincent van Gogh believed that “Colour express something by itself” (cited in Shlain 1991, p. 175). These beliefs of Gauguin and van Gogh about the emotional power of colour support the connection between art and psychology (Shlain 1991). In this sense, the theory of planned behaviour proposed by the psychologist Icek Ajzen (Ajzen 1991), which focuses on influences on the creation of human intention and behaviour, can be used as a framework to identify the factors that may affect individuals’ (and specifically architects’) behaviour and intentions towards colour choices. The theory consists of three determinants of intention that can predict human behaviour: (1) attitude towards the behaviour, which refers to the personal evolution of behaviour; (2) subjective norms, which refer to socially expected behaviour in different situations; and (3) perceived behavioural control (ability), which refers to a person’s degree of self-efficacy and anticipation of ease or difficulty in performing the behaviour (Figure 2.16).
In relation to the psychological influence of colour on human, Mahnke believes that colour is “a part of conscious, subconscious and unconscious, and experience that is integral to human behaviour”, while he considers human reactions to colour as a result of not only psychological aspects but also physiological aspects of human behaviour and experience. From an environmental design perspective, Meerwein et al. (2007) suggest three parameters of seeing, perceiving and experiencing colour, based on the spatial colour experience pyramid of Mahnke (1996), to explore the complex relationship between colour and people. In this model, which has much in common with Ajzen’s planned behaviour model, Mahnke identifies six factors that may affect an individual’s colour experience and explores the important role of colour in the design process in order to help architects and designers to adapt a new approach in consideration of colour in their design (Mahnke 1996) (Figure 2.17).
The first level of the model is biological reactions to a colour stimulus. “Color is a gift of evolution, an inherited characteristic for the survival” of different species including humans (Mahnke 1996, p. 10); for example, the development of colour vision enables us to recognise ripe fruit and rotten vegetables. Colour vision is not just an optical tool for distinguishing between things, but includes biological functions by carrying light and colour stimuli through the neural pathways to the brain, which has an impact on the production and release of hormones. This can explain changes in human physiological and psychological reactions in being confronted with different colours. The second recognised parameter is the collective unconscious. This archetype includes fundamental images, original patterns, experiences and stored knowledge from millions of years of development in our genetic map as a species. Conscious symbolism – associations – is the third level of the pyramid, and includes symbolism, impressions and associations on a conscious level such as association of colours with natural features, which is common across different cultures, for example associating blue with the sky. The symbolism of colour and the meanings associated with it also play a significant role in religion, art, healing processes and philosophy.
Chapter 2: Literature Review

The next two levels of the pyramid, cultural influences and mannerisms, and influences of trends, fashions, styles, are also related to colour symbolism and association. Therefore an individual’s religion, culture and beliefs in addition to common trends and fashions can influence their colour experience, judgement and even attitude towards colour. Personal relationship with colours is the last level of Mahnke’s pyramid and includes personal characteristics, temper, physical and psychological constitution, age, gender and even personal experience. All these factors should be considered parameters that may influence our colour experience.

In this study, human responses to colour have been investigated based on three categories informed by Mahnke’s colour experience model and Ajzen’s theory of planned behaviour: (1) colour and physiology, which includes colour vision ability, age, gender and personal characteristics; (2) colour and psychology, which includes all aspects of personal moods, attitudes, unconscious feelings and experiences, perceived control behaviour, and psychological and biological reactions; and (3) colour and cultural semiotics, which includes conscious symbolism, the collective unconscious, subjective norms and the influence of trends. It should be mentioned that the researcher is aware of the vast literature on the relationship between colour and people; however, as investigation of all aspects of the colour–human interface is not possible in this research, the literature presented has been selected in relation to the research question and the discipline of architecture.

2.3.1 COLOUR AND PHYSIOLOGY

The perception of colour is the subject of much research in different fields. As stated in the section on the nature of colour, from the point of view of physics the colour created through a beam of light depends on the reflected wavelength from that surface and colour vision is an illusion resulting from the interactions of billions of neurons in our brains (Gouras 2009). The ability to see colour depends on the
 existence of three elements: (1) two properties of light, energy and wavelength; (2) the object (the quality, texture and orientation of its surface); and (3) the recipient (their eyes) to perceive and process the colours. Absence of or changes in any of these elements and the anatomical structure of an individual’s eye have a significant impact on the final colour perception (Meerwein, Rodeck & Mahnke 2007). The perception of colour is unconditional and consistent; however, what we finally perceive as the colour of a specific object may be different from what we actually see. The reason is that our brains perceive colour according to our knowledge, familiarity and experience. As such, when faced with new and unknown objects, colour can be considered an individual sensory phenomenon, which can be highly variable (Lancaster 1996). According to Monica Billger, the variety of perceived colours has a relationship to the conditions of observation (Anter.K.F 2010).

The process of seeing colour is comprised of three stages. In the first, a beam of light strikes the surface of the object and, with a selective absorption mechanism, the object absorbs part of the electromagnetic wavelength and reflects the rest. The colour of the object is defined at this stage, according to which wavelength is reflected into the eye. The second stage involves receiving, seeing and processing colours (Meerwein, Rodeck & Mahnke 2007).

The retina is the innermost layer of the spherical lens of the human eye and plays an essential role in colour vision. It contains about 100 million rod cells and around six million cone cells, which are connected to optic fibres. However, only one millions of these cones convey information to the brain cortex (Lancaster 1984). The arrangement of the rods, which are more sensitive in low light, is around the perimeter of the retina, whereas the cones, which are more sensitive in high levels of light, are located in the centre (Lancaster 1984). As the rods are more sensitive to short wavelengths such as blue-green, they enable us to see our surroundings in low
light. Cones are more sensitive to longer wavelengths such as yellow, and are divided into three types with different sensitivities. Some are more sensitive to short wavelengths such as blue, some to intermediate wavelengths such as green and others to longer wavelengths such as red. At the final stage, processing the visual messages that are received from the cones and rods by the brain, colours gain meaning and are recognisable to us (Figure 2.18).

![Figure 2.18: The structure of the eye (source: www.patient.co.uk/pilsinl/185.gif)](image)

Following colour elasticity theory, it should be noted that the human visual system has special properties that influence the perception of colour. In order to identify colours in different situations, the human visual system pretends that the colour of an object is unchangeable. Thus, it tries to perceive colours in relation to previous experience and memory (Lancaster 1996). In other words, the human brain and visual system prefer to receive the highest amount of information with the lowest effort that enable them to define the colours of object in different conditions. This tendency of colours to maintain their original identity despite environmental changes such as illumination is known as the ‘colour constancy’ phenomenon (Lancaster 1996). Hence, although the colours of a specific object such as a tree may change in different light sources or distances from grey to blue, according to our
experience we know the colour of that tree is green. Another property of the human visual system is called ‘simultaneous adaption’. Ewald Hering believes that the human eye can adapt itself to the level of illumination. This is why, after entering a dark place, we can recognise the place, its settings and their colour depending on the level of illumination in seconds (Franklin. C. L 1929).

Another theory that can be used in investigation of colour perception is Gestalt theory. Moreover, it is argued that colour perception meets all the regularly applied Gestalt criteria, as does the perception of shape that the emergent features of colour reveal (Pomerantz. J. R 2006). Thus, for investigating colour perception, the Gestalt theory can be considered. However, it should be mentioned that investigation of the issue of colour perception is a vast area of research and is outside the scope of this dissertation.

A person’s colour vision acuity is one fundamental factor affecting colour use and preference. It has been argued that human vision is able to distinguish between two and ten million different colours (Gouras 1991; Pointer & Attridge 1998). However, individual differences in human colour vision and visual disabilities such as different types of colour blindness, gender and age may all result in different colour perceptions. According to estimates by the Howard Hughes Medical Institute in 2006, approximately 7.0% of the male population and 0.4% of the female population suffer from colour vision disabilities, most of whom cannot differentiate red from green or perceive them differently to other people (Mandal 2014). Due to differences in emotional and physiological status, Bilmer et al. suggest that gender should also be considered an influential aspect in visual colour perception, preference and thus choice (Bimler, Kirkland & Jameson 2004). Colour acuity is also influenced by ageing. Age-related physiological changes in the retina, thicker corneas, denser and more yellowish lenses, reduction in pupil size and changes in
Chapter 2: Literature Review

the visual nervous system all result in a gradual decline in visual function, quality and sensitivity to colour contrast (Ou et al. 2012; Pinheiro & Da Silva 2012). Therefore, this variation in human colour vision ability requires more attention from designers, especially in designing for different ages.

2.3.2 COLOUR AND PSYCHOLOGY

The psychological responses to colour have been the subject of study by many researchers from different disciplines such as psychology, marketing and architecture. Based on laboratory studies, some believe that colour has the capacity to arouse excitement or calm individuals. It is also argued that colour can influence peoples’ feelings, moods and behaviours (Birren 1961, 1978a). However, considering the limitations of laboratory studies such as small sample sizes, extension of the results beyond the evidence in many of these studies has come under sharp criticism by other researchers and they should be viewed with caution (Wise & Wise 1988). The existing research on the psychological impact of colour can be loosely categorised into four groups: (1) colour use for therapeutic purposes; (2) colour use due to its psychological influence in different contexts such as healthcare, education and office environments; and (3) the synaesthesia effects of colour; and (4) colour use for marketing purposes.

The belief in colour’s healing power and the association between colour, emotion and physical wellbeing have been present from ancient times in different communities, such as ancient Grecian, Egyptian and Hawaiian traditions (Graham. H 1996). Considering its influence on individuals’ psychology, emotions, bearings and sense of wellbeing, a number of research and therapeutic practices have been conducted on colour as a contributing factor to the quality of healthcare design. For instance, Carruthers et al. (Carruthers 2011; 2010) developed a new colour wheel called the Manchester colour wheel as an assessment tool for exploring the moods
and emotions of individuals who suffer from communication difficulties in order to predict their response to treatment. The Manchester colour wheel contains eight colours in addition to grey, black and white. Colours have been recorded in positive and negative terms; for example, the colour grey is associated with depression and anxiety (Carruthers et al. 2010).

Moreover, some researchers have studied colour in the context of occupational therapy. For example, Withrow (2004) suggests that the use of colour in art therapy can help clients reach deeply into their unconscious thoughts in order to release their emotions and feelings. In The Book of Colour Healing (1994), Gimbel attempts to enhance readers’ awareness of the healing powers and energies of colour and its relationship to human health and the chakra system. He also offers psychological tests for diagnosing health and sickness, as well as introducing different methods of colour meditation and colour therapy (Gimbel 1994).

Several studies have focused on the positive and negative influences of specific colours on individuals’ performance and emotions. For example, Frank and Gilovich (1988) examined the influence of black uniforms on the behaviour of professional sportspeople. Their laboratory experiments and review of the penalty records of the US national football and hockey leagues reveal that the use of black uniforms not only increased the aggressiveness of the players, but also resulted in more biased judgements of referees (Frank & Gilovich 1988). A study by Elliot and Niesta (2008) focused on the romantic influence of red colour in enhancing men’s attention to women.

According to Lüscher (1971), the process of colour selection is an unconscious action that can reveal the personality of its selectors. He argues that his colour test, which consists of eight cards, coloured and numbered, allows access to
unmeasurable data (psychological aspects) through recording the most liked and disliked colours in two continuous tests (Lüscher, M 1971).

There has also been research on the influence of specific colours on human behaviour, performance and wellbeing (Elliot et al. 2007; Yu & Yoon 2010). A study by Parks and Volpe (2013) explored the therapeutic influence of colour in enhancing a sense of wellbeing in adult learners dealing with mental health issues. A nine-week colour awareness exercise entitled the Colour for Wellbeing (CfWB) program revealed that colour awareness had a positive influence not only on the physical and mental health of participants, but also on their moods and behaviour (Parkes & Volpe 2013). It is argued that the impact of colour on human emotions, feelings and perceptions makes it one of the most influential factors on the way people feel about their environment.

Hutchings raises the issue of ethics in colour use when asking “can we hurt people through using colour?” (2006, p. 87). He considers the ethics of colour use not only in environmental design and architecture, but also in food, product packaging and marketing (Hutchings 2006). However, this issue has not been addressed in any of the national environmental assessment methods for buildings (Yu & Yoon 2010).

Synaesthesia is a cross-sensory experience in which one sensory stimulus is accompanied by another. Due to holistic associations and parallel sensations, colour is not only related to the sense of sight but is also able to stimulate other senses such as touch, hearing, temperature and smell (Kwon 2010, p. 26). Therefore colour can create a clear sensory perception through other sensory channels and allow a synaesthetic person to taste, feel or hear colour. In this sense, they may experience a specific colour whenever hearing a particular tone or music, or undergo a specific colour experience whenever they encounter a certain letter or number, as in
grapheme–colour synaesthesia; for example, ‘4’ may be yellow (Edquist et al. 2006; Ramachandran & Hubbard 2001). Synaesthesia also offers reasons for the perception of a certain colour nuance or combination as warm or cold (sense of temperature), hard or soft (sense of touch), sweet or sour (senses of taste and smell).

Several research and experimental studies have examined the influence of colour on perceptions and experiences of weight, size, temperature, sound and even taste and smell. According to Wise and Wise (1988), “the visual metaphors in language thus make stereotypic use of color and temperature through images that pervade our popular folklore” (Wise & Wise 1988, p. 53). Studies by Tinker (1938) and Wright (1962) reveal that colour has an impact on the sense of temperature (touch); however, the results of other studies, such as an experiment by Morgensen and English (1926), show no change in sense of temperature in relation to different colours. Similar studies have been conducted on the relationship between colour and perceptions of size, weight and taste. As most of these tests were conducted in a laboratory or controlled environments, it is difficult to apply their findings to real-world situations.

Considering the impact of colour on human behaviours, feelings and perceptions, colour has been studied in the realm of business and marketing as a tool to stimulate buyers’ interest and increase the appeal of products (Garber & Hyatt 2000). For instance, a study by Funk and Ndubisi (2006) examined the relation between colour and product choice in relation to the influence of gender on colour proclivity and consumer choice.

2.3.3 CULTURAL SEMIOTICS

When considering the impact of culture on colour use in architecture three questions need attention; what is culture?; how does it inform architecture?; and how does it inform colour use.
The Center for Advanced Research on Language Acquisition (CARLA 2016) defines culture as “shared patterns of behaviours and interactions, cognitive constructs and understanding that are learned by socialization”. Moreover, Greetz (as cited in Kwon 2010) defines culture as “a historically transmitted pattern of meanings embodied in symbols, a system of inherited conceptions expresses in symbolic forms by means of which people communicate, perpetuate and develop their knowledge about and attitude toward life”. According to Barkow et al. (1992) culture can be distinguished in three categories: (1) metaculture, which is a biology that makes human distinguishable from other species; (2) evoked culture is a domain-specific mechanisms, which resulted by biology in different ecologies; and (3) epidemiological culture is a result of the evoked culture that leads to within-group similarities and between-groups differences epidemiological culture.

Therefore, cultures are "value-guided systems...Values define cultural man's need for rationality, meaningfulness in emotional experience, richness of imagination, and depth of faith"(Laszlo 1972, p. 101). According to the complexity of the cultural system, it must be reviewed and analysed as a whole in its specific context. As the role of some aspects in cultural system may not be as important as others, it would be better to select a set of aspects that has been found to be the most influential in the study of the culture in respect to the study focus. In this sense, the set of aspects of the cultural system that are discussed in this study are limited to those that may have influence on architecture.

Eliot (1949, pp. 13-4) believes that for survival and growth of culture, three conditions are needed: (1) “Organic structure”, which refers to trasmission of culture to new generations; (2) “analyzable, geographically”, into local culture that refers to cultural responses to regional context such as: available sources and natural materials; and (3) “balance of unity and diversity in religion.” Accordingly, the
influential aspects of culture on architects, and consequently on architecture, might be seen to be: (1) the strength of cultural transmission from previous generations to architects, which includes the role of language systems and semiotics (2) the local context and geography of their living area, and (3) the role of religion in their cultural background.

Edward Hall, in his “The hidden dimension” (1969), argues that different cultures experience different sensory worlds. He believes that “selective screening of sensory data admits some things while filtering out others, so that experience as it is perceived through one set of culturally patterned sensory screens is quite different from experience perceived through another.” Thus, architectural and urban environments are the “expressions of this filtering-screening process” (1969, p. 2).

A further important aspect of culture that has influence on design is suggested by Rapaport, namely the relationship between culture and nature. He suggests three classifications for this relationship, each of which informs different types of architectural response: (1) “religious and cosmological”, which refers to natural environment as a dominant force that is valued over humankind; (2) “symbolic”, where neither humankind and nature has dominance; (3) “exploitative” that refers to situation that humankind is dominant over nature (Rapoport 1969, p. 75). In addition, in his seminal study on house form, Rapaport suggests five aspects of culture that can influence architectural form: (1) the basic needs of society such as comfort and cooling/heating; (2) family structure and hierarchy; (3) the varied role of women within society; (4) attitudes toward privacy in relation to territoriality and sex; (5) the level of social interaction i.e. how much people gather outside, in café or shopping mall. (Rapoport 1969, p. 61).

When investigating the impact of culture on design, it should be considered that culture is a dynamic system that is constantly changing and evolving in respond
to the altering outside world. In the realm of architecture, review of architectural styles and forms can reveal the fluctuation of cultural system and the evolving needs of the society. Technological advances, advent of new materials and techniques, and the influence of media are thus influential factors that not only change shape the cultural system and needs of people, but also inform new architectural approaches.

The long-held human perception of colour as engendered with spiritual qualities and cultural significance can be seen from as early as the wall paintings of primitive peoples in Lascaux and Altamira demonstrate (Porter & Mikellides 1976, p. 22). The symbolic meaning of colour has been celebrated across cultures in religious and moral domains relating to customs, beliefs, habitats and specific culture (Lenclos 2004, p. 24). Moreover, Mahnke (1996, p. 10) suggests that life experience, which has a robust relationship with culture, is an influential factor in the creation of colour meaning, which is valued in language. Thus colour meanings needs to be considered in their cultural context and never alone (Smith 2003, p. 365).

As environmental geography and local materials have a strong relationship with culture, they should also be considered influential factors on colour meaning, importance and choice. Swirnoff’s “vernacular eye” and Lenclos’s “geography of colour” resulted in the expression of remarkably different colour palettes from place to place according to geographical, religious and climatic conditions (Lenclos 2004). Accordingly, the vernacular colour palette is recognised as a component of the visual and cultural language of any region (Lenclos 2004; Swirnoff 2000). In this sense, culture may influence colour preference and choice through different factors, including: symbols and meanings, geographical conditions, vernacular and natural features, and chromatic expressions of a given region or country based on its aesthetic tastes, religious beliefs and other socio-cultural influences (Lenclos 2004). For instance, the African Ndembu tribe, the Upanishads of India and the
Hawaiians ascribe specific colours to mysticism and signs of gods (Parkes & Volpe 2013) and in Islamic countries such as Iran, green is the symbol of resurrection and recalls the ‘garden of delight’ to its believers. Such differences in the importance, value and use of colour in different cultures may influence colour preference and choice (Lenclos 2004).

According to the colour experience model of Mahnke (1996) and Ajzen’s theory of planned behaviour (1991) described in Section 2.3, culture consists of different layers that consciously or unconsciously influence the interpretation of colour and finally the behaviour and attitude towards the choice of colour. Therefore, to investigate the relation between colour and culture comprehensively, three main aspects of culture need to be considered: (1) colour symbols and meanings, which relate to cultural colour symbolism, association and value; (2) colour orientation (preferences and attitudes), which consist of personal characteristics, demographics, psychological and biological conditions, cultural norms and perceived behavioural control; and (3) colour in language, which relates to the value of colours in different languages and cultures.

In addition the influence should not be forgotten of other cultural factors on architect’s colour choice, such as technological development, advent and access to new materials, and cultural expresion via visual media as TV, social media, and contemporary fashion.

2.3.3.1 COLOUR, SYMBOLS AND MEANING

A symbol is an image that stands as a representative of an object and communicates an associated meaning. The human experience of colour in nature which has been stored in our genetic memory influences our personal experience of colour (Meerwein, Rodeck & Mahnke 2007, p. 28). According to Zahanin (as cited in Lenclos 2004), there is a robust relationship between colour and symbols. Colour
symbolism contains tradition of meanings associated with colours that can influence our emotions, experiences and colour preferences. Colour symbolism and meaning are created through sharing experiences and exchanging knowledge via social interaction and they reflect cultural values and norms. In this sense, colour may contain a variety of meanings even in one culture, so colour symbols and meanings should be considered in the cultural and geographical context.

The rainbow, as a perfect example of luminous colours, symbolises communication between humans and other worlds. In the Christian Bible, the rainbow has been recognised as a message of hope between God and humans and interpreted as a sign from God since ancient times (Lenclos 2004). The daubing of a corpse with red ochre to prepare the deceased for life beyond the grave is another example of colour use as a symbol and as life-giving (Porter.T 1982).

Moreover, the theory of the four elements from 4–5 BC, based on a hypothesised relationship between colours and the natural elements, confirms the important role of colour in human life from ancient times. This theory became the starting point of all subsequent colour systems up to Newton (Gage 1999). The theory of the four elements illustrates the harmony of earth, air, fire and water as the four elements of nature. Gaston Bachelard, a French philosopher, believed these elements are the best basic materials for imagining nature and have always been associated with colour from ancient times. It should be mentioned that the number of colours that are attributed to these elements have great diversity around the world due to culture, religion and so on. These symbolic colours may transform the image of nature and also play a crucial role in determining value in the eyes of communities by shaping aesthetic awareness and symbolic meanings (Young-In 2006).

For instance, the Mayans believed in five symbolic pigments relating to the life cycle. They recognised red as a symbol of blood and birth, yellow for corn, blue-
green for water and fertility, black for death and white as change (Lenclos 2004). The Chinese five primary colours correspond to the five primary elements of seasons and directions. According to Leonardo Woolley, the Mesopotamian civilisation’s ziggurats are an example of colour use in the ancient world as a symbol of the planets of the solar system (Porter.T 1982). In this regard, in any country or region particular colours are symbols with special meanings, beliefs and events. In desert cultures, green is the colour of life. In Islamic countries such as Iran, colours like green are a symbol of resurrection (Meerwein, Rodeck & Mahnke 2007, p. 28). The African Ndembu tribe, the Upanishads of India and the Hawaiians ascribe specific colours to mysticism and signs of gods (Parkes & Volpe 2013). Since their usefulness and functionality were not the only concern of early builders, the use of colour and coloured images in ancient dwellings show their functional role in protecting the dwellers from spiritual powers.

2.3.3.2 COLOUR ORIENTATION (PREFERENCE AND ATTITUDE)

Research on colour preference and attitude has been largely restricted to the disciplines of health, marketing, psychology and chemistry. According to Lee and Lee (2006), human emotional responses to colour can be described as: (1) unconscious (innate response); (2) semiconscious, achieved through learning and cultural or climatic factors; and/or (3) a conscious response known as preference, which can result from personal experience, personality, fashion trends, contemporary culture and social semiotics. While the relationship between colour preference and attitudes to colour has been the subject of much study over a long period, the literature suggests that the relationship between colour use and preference is “bewildering, confused, and contradictory” (McManus, Jones & Cottrell 1981). The literature also reveals a lack of agreement on the origins of colour preference. Some research suggests that colour preference is entirely a
subject of personal taste, depending on individual associations and other subjective factors (Chandler 1934; McManus, Jones & Cottrell 1981). In contrast, other studies describe colour preference as an objective phenomenon partly depending on inherent stimulus properties (Granger 1952; Ou et al. 2004), which explains universal preferences for some colours such as blue. There is not, however, sufficient experimental evidence for either an extreme subjectivist or objectivist point of view.

Colour preference might normally be understood as the tendency for an individual or a group to prefer some colours over others, such as having a favourite colour. Colour preference is theorised to depend on the situation/context of colour choice, the underlying associations that people may have developed (Grossman & Wisenblit 1999) and many other factors such as gender, age and emotional experiences.

Gender difference is another factor that has been investigated in relation to colour preference. While some studies have not found any evidence for gender differences (Bimler, Kirkland & Jameson 2004), others have suggested that colour perception and preference may be influenced by gender (Funk & Ndubisi 2006).

In early the 1940's Eysenck noted the following results in a review of studies into the relationship between gender and colour (Eysenck 1941). In a study of preference for either blue or red, Jastrow (1897) found that men preferred blue and women preferred red. The reasons for this might be explained by a study of St. George (1938, p. 716) who asserted that blue stands out more for men than for women. In similar studies, Dorcus (1926, p. 432) found that yellow had a higher affective value for men than for women, Eysenck's own study found orange to be preferred over yellow by men, and yellow over orange by women, and Birren (1952)
found men preferred orange to yellow while women identified orange as their least preferred colour.

Guilford and Smith (1959) found men tended to be more tolerant than women toward achromatic colours, and thus suggested that women might be more colour-conscious with more flexible and diverse colour tastes. McInnis and Shearer (1964) found that 56% of men and 76% of women preferred cool colors, and 51% men and 45% women preferred bright colours. They also found women preferred tints more than shades and favoured blue green more than men did. Similarly, Plater (1967) found men largely preferred stronger chromas than women did.

Kuller (1976) investigated the physiological and psychological effects of colour in two opposite environments - one room colourful and complex and the other grey and sterile. He found that pulse rates for both sexes were faster in the grey room, men were overall more stressed than women and more bored than women in the grey room.

Thomas, Curtis, and Bolton (1978) found a significant difference between men and women when they asked 72 Nepalese to list the names all the colours they could think of. Although the women consistently listed more colours, the cultural context of the research was identified as possibly explaining this finding because Nepalese women traditionally wear more colourful clothing. Similarly, when Greene (1995) asked college students to identify the colours of colour chips, it was found that women recognized significantly more colours than did the men, and that these gender differences might be due to the different socialization of men and women. Radeloff (1990) found that women were more likely than men to have a favourite colour, and that women preferred soft colours while men preferred bright ones.
When Hurlbert and Ling (2007) explored cross-cultural gender difference in colour preference, they found significant differences in the weights of the two fundamental neural dimensions that underlie colour coding in the human visual system. These dimensions are cone–opponent contrast components containing: (1) one achromatically opponent mechanism (light–dark (L+M); and (2) two chromatically opposing mechanisms (red-green (L-m cone) and blue-yellow (S–(L+M)) (Vincent et al. 2010). Hurlbert and Ling theorise that these differences may be linked to the evolution of gender-specific behavioural uses of trichromacy – the quality of having three independent channels for conveying colour information in the eye (2007). Despite the probability of innate difference between males and females in colour preference, other factors such as cultural context, social semiotics and individual experience may also modulate colour preferences and attitudes.

In general, attitude refers to a relatively enduring organisation of beliefs, feelings, and behavioural tendencies to respond positively or negatively towards a certain idea, object or situation (Hogg & Vaughan 2005). Thus, an individual’s attitude towards colour or a particular colour will affect their choice of colour (Funk & Ndubisi 2006). According to the ABC model (Eagly & Chaiken 1993), attitude in general contains three components: (1) affective component, which is a person’s emotions or feelings; (2) behavioural component, which is a person’s intended behaviour (positive or negative); (3) cognitive component, which is a person’s beliefs, values, or opinions held consciously.

Due to the robust relationship between colour and symbols, other than the influence of personal (unconscious), geographical and climatic (semi-conscious) conditions on colour attitudes, religious, cultural and social semiotics and norms (conscious symbolism) may also modulate individual colour preferences and attitudes towards colour use. Conscious symbolism and subjective norms refer to
“to the perceived social pressure to perform or not to perform the behaviour’’ (Ajzen 1991, p. 188). In this sense, individuals’ behaviour (colour preference and choice) may be influenced by the feelings and opinions of others (in the profession of architecture, this can be the public, clients and peers) in making colour choices. A study by Funk and Ndubisi (Funk & Ndubisi 2006) examined the influence of the salience of normative colour on marketing and product choice by consumers. For instance, meanings associated with the colour pink in Western cultures such as Britain not only make pink a marker of social identity – connected with femininity and related to qualities such as softness and delicacy – but also inform its use as a code for broader demographic categories of religion and gender (Koller 2008). In this sense, it is not only that colour itself acts as a group marker, but that sensitivity towards colour and colourfulness as such markers may influence individual colour preferences and attitudes towards colour use.

Moreover, in relation to subjective norms, which are shaped via cultural, religious and geographical factors, Ajzen (1991) identifies another factor that can influence final colour choices. Perceived behavioural control, which can be a semi-conscious or unconscious parameter, refers to the perceived and anticipated ease or difficulty of performing a particular behaviour or action, in this case colour choice (Ajzen 1991). The role of perceived behaviour control on colour preference and choice may be influenced by various factors such as individuals’ perceptions of their ability to perform a given behaviour (Ajzen 1991), the degree of their colour knowledge and experience, fashions and philosophies about colour, social norms and other people’s opinions.

A preference might also favour achromatic tones from white to black and, when it comes to a complex multi-component objects such as a building, preference might favour a more restricted colour palette over a highly colourful palette. Hence,
it is important to differentiate between colour preference and colourfulness preference – the latter being a measure of how colourful an architect’s design preferences are. In this study, colour attitude refers to an architect’s beliefs and behavioural tendencies in relation to colour use in general in architecture and more specifically according to design context e.g. interior or exterior, at different stages of the design process, for different functions of buildings, for different locations, communicating contextually mediated meaning. Moreover, to signify a theoretical combination of colour preferences and attitudes, the term colour orientation is used in this study i.e. all those preferences, beliefs and behavioural tendencies towards colour that an architect brings to every project and which varies little between projects.

2.3.3.3 COLOUR AND LANGUAGE

Human vision is capable of identifying and distinguishing between two to ten million colour variations (Gouras 1991; Pointer & Attridge 1998). However, a lack of sufficient vocabulary for naming colours in different languages makes the definition of that wide range of colours impossible. For example, only 3000 words have been listed in the English dictionary for colour recognition (Maerz & Paul 1953). As stated in Section 2.3, Wittgenstein was one of the first philosophers to bring the complex phenomenon of colour into linguistic realm, and he warns about the power of verbal orders and language games and their effect on colour observation and imagination, which results in prejudice in the use of words and concepts (Riley 1995; Wittgenstein 1978). Moreover, Eco believes that in order to recognise and express a non-verbal experience such as seeing colour, it needs to be filtered through a linguistic system (Eco 1996, p. 159). Therefore, our experience and knowledge of colour are influenced by the ability and power of verbal language.
Berlin and Kay (1969) developed a model of basic colour terms in seven stages in order to investigate the number of colour words in different languages. The model proposes that the most fundamental colour names, which are used more than any others in languages, are ‘black’, ‘white’ and ‘red’. Black and white are found in the first stage of the model, followed by red, which is commonly used to describe a range of colours from yellow to brown; green and yellow; yellow-green, blue, brown and purple-pink or orange-grey (Berlin & Kay 1969). By adding a cultural scheme, Marable (1991) expanded Berlin and Key’s study and she argues that idiomatic usage of colour terms can shed light on the value systems of different cultures (cited in Kwon 2010, p. 30). In some languages, a particular need for colour discrimination has led to the appearance of a large vocabulary for specific colours. For example, Inuit peoples (Eskimos) have 17 different terms for ‘white’ (Lancaster 1984). A lack of colour vocabulary has an effect on perception and recognition of certain colours (Gage 1999), which also may have an impact on colour selections and preferences in certain societies.

2.4 COLOUR IN THE ARCHITECTURAL REALM

The review of the relationship between colour and people in Section 2.3 reveals that colour has been studied through the lens of different disciplines, but few studies have been done on the use of colour in architecture. As philosophical approaches and attitudes towards the importance and use of colour in architecture have undergone transformation over time, a study of colour specifically in relation to the history of architecture seems necessary. Although the use of colour in the decoration of habitation has been seen since early cave paintings, it is arguable that the colour history of architecture shows colour has remained largely subservient to line in representing meaning and thus is normally treated as only an adornment to form and
object. As stated in *Chromophobia*, Batchelor (2000) argues that the use of colour in art and architecture is seen as dangerous territory.

This section discusses the history of colour in architecture in four time periods: ancient times, the 19th century, the 20th century and the 21st century. It should be mentioned that, as the history of colour is a broad field with a connection to different disciplines, this research attempts to select those sources which are more directly related to the history of colour in architecture, rather than art and paintings. Figure 2.19 presents a summary of important movements and people in the history of colour who have had a special impact in the use of colour in architecture. This is followed by a review of studies that have been done on the use of colour in architecture. The outcome of this section provides the context for investigating colour in architectural education and knowledge.
2.4.1 COLOUR IN ANCIENT TIMES

The power of colour was appreciated from ancient times in the wall paintings of early cave people. They did not use colours only for enhancing the form of their painted images, but also because of the magical meanings and power of colour in protecting them from natural disasters and evil spirits. The cave painting found in Lascaux and Altamira demonstrates early humans’ desire for colour (Porter & Mikellides 1976). Contrary to its name the Dark Ages (5th–15th centuries), use of strong and vibrant colours in painting and architectural decoration such stained-

---

**Figure 2.19: Summary of the history of colour in architecture (source: author)**

<table>
<thead>
<tr>
<th>Era</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ancient</strong></td>
<td>Colour = Magical power, culture, meaning</td>
</tr>
<tr>
<td><strong>Renaissance</strong></td>
<td>Form vs colour/ decrease in colour use</td>
</tr>
<tr>
<td><strong>19th Ce</strong></td>
<td>Hittorff discovery: Changed attitude and attention to colour</td>
</tr>
<tr>
<td><strong>De Stijl movement</strong></td>
<td>New attitude toward colour use/ primary bright colours</td>
</tr>
<tr>
<td><strong>Bauhaus</strong></td>
<td>Change in Colour education</td>
</tr>
<tr>
<td><strong>Modern architecture</strong></td>
<td>Decrease in colour use Change attitude towards colour</td>
</tr>
<tr>
<td><strong>21th Ce</strong></td>
<td>Robert Venturi New attitude and attention to colour</td>
</tr>
</tbody>
</table>

---
glass windows was a significant element of medieval art (Van Leeuwen 2011, p. 71). Yet despite the importance of colour since such times, it has remained largely subservient to line in representing meaning and thus normally treated as an unnecessary addition to form and object.

This disconnection of line from colour continued into the Renaissance (Minah. G 2008) and was then reflected in separation of the fine arts from architecture. According to Victor Vasarely (cited in Porter & Mikellides 1976, p. 26), this split resulted from: (1) the advent of humanism and the quest for knowledge, which led to role specialisation within art and science; and (2) new interest in ancient Roman culture and rediscovery of classical philosophy with their restrained colour palette, resulting in seeing medieval colour symbolism as hair-splitting and consequently the birth of the concept of a ‘work of art’. By rejecting colour as a symbol of environmental language, a creative Renaissance man was encouraged to use colour naturalistically to represent depth and create a three-dimensional illusion to demonstrate the real colour of the world, for example the study of colour and its relationship to light and weather by da Vinci (Porter & Mikellides 1976, p. 26; Van Leeuwen 2011). Consequently, from the Renaissance onwards the rich use of rich colour in architecture, commonplace in the Middle Ages, decreased.

This is reflected in particular by the divide between colourists and designers in 16th-century Venice brought about by scholarship in the science of colour theory, which is concerned with the physics and chemistry of colour, rather than its meanings, that was further developed in the Italian Renaissance (Porter & Mikellides 1976). Some of the key texts, such as those by Dionysius of Halicarnassus and Isidore of Seville, illustrate the evolution of line into chiaroscuro and colours (Gage 1999). Moreover, two of the earliest sources that address colour, Ten Books
of Architecture [De architectura] (20 BC) by Vitruvius and Ten Books [De re aedificatoria] by Alberti, are focused specifically on architecture, and natural and artificial colours, and argue for purity and simplicity when colour is used for decoration and adorning walls (Alberti 1988).

2.4.2 COLOUR IN THE 19TH CENTURY

In the mid-19th century, the archaeologist Jacques-Ignace Hittorff raised a new interest in and attention to colour, and especially to the use of colour in the exterior of buildings (Figure 2.20). A belief in the monochromatcity of ancient Greek architecture had resulted in a decrease of colour use in facades. In unearthing ancient Greek temples and statues, Hittorff found the Greek building facades were coated with bright pigment layers that displayed the Greeks’ love of colour. This exploration changed a long-held view about the monochromaticity of Greek architecture and created a new chapter in the history of colour use (Caivano 2005; Porter & Mikellides 1976; Porter.T 1982).

Figure 2.20: Phideas and the painting of the Frieze of the Parthenon, Sir Lawrence Alma-Tadema, 1863, showing the Greek love of colour in architecture (source: Porter 1982)
The misconception about the ancient love of colour in architecture resulted in neglect of the various evidence of colour use in prehistoric caves like Lascaux, burial chambers and the remnants of cities such as Pompeii. Moreover, such interest in the use of colour can also be found in the Romans’ coloured buildings, which were influenced by the Greeks. Moreover, the great power of the Roman empire influenced the use of colour in medieval architecture, which can be seen later in the exterior of Gothic buildings with bright colours (Durao 2012; Porter & Mikellides 1976).

Thus, it might be argued that the discoveries of Hittorff created a paradigm shift in the history of colour in architecture. However, while the discovery of the colourful ancients had a great influence on historians, artists and designers, the acceptance of this paradigm shift in the design world took a longer time. For example, the 18th-century Neoclassicist architects adhered to their belief in monochrome Greek architecture and coloured their buildings grey, white or in monochrome (Caivano 2005). The immediate effect of this discovery can be seen in the polychromatic architecture of Hittorff and Owen Jones. The use of colour in Jones’s architecture as a colourist of the Crystal Palace may relate to the early Impressionist movement, which had a great importance in painting and later in architecture (Fagerström.K 2005). In his seminal book *The Grammar of Ornament* (1856), Jones offers guidance to future designers through his detailed analysis of the ornaments and decorative elements of different cultures, and his manifesto of general principles, in which colour plays a significant role (Jones 2016, p. 12). Of 37 general principles on the arrangement of form and colour in architecture and the decorative arts, 24 propositions are specifically about colour and have been categorised into seven sets of propositions: (1) on colour generally; (2) on the proportions by which harmony in colouring is produced; (3) on the contrasts and
harmonious equivalents of tones, shades and hues; (4) on the positions the different
colours should occupy; (5) on the law of simultaneous contrasts of colours derived
from Chevreul; (6) on the means of increasing the harmonious effects of juxtaposed
colours; and (7) on imitations (Jones 2016, pp. 25-9).

Moreover, in the elimination of Greek colour misunderstanding, the thought
and beliefs of John Ruskin had a great influence on the architects and artists of the
19th century and later on the pioneers of modern architecture. He argues that the
principal role of the artist is “truth to nature”. In The Seven Lamps of Architecture
(1849), Ruskin introduces seven moral categories which include consideration of
colour: sacrifice, truth, power, beauty, life, memory and obedience. He advocates
the honesty of materials without any paint (Ruskin. J 1849). However, although he
visualises sculpture in monochrome, he takes a different approach to the use of
colour in architecture. He believes in using colour in architecture by learning from
nature. The influence of Ruskin’s philosophy can be seen in the writings of Eugène
Viollet-le-Duc, who believes in material honesty as well. Their similar approaches
to colour use resulted in the appearance of brutalism in the Modern architecture of
the 20th century and they can be seen as the first theoreticians of modern architecture
(Caivano 2005).

After the industrial revolution in the 19th century, criticism of the aesthetics
and monotony of industrial cities led to social and aesthetic reforms, such as the
reforms of the Wilhelmine Period (1890–1918) in Germany. The German lyric poet
Ferdinand Avenarius was one of the critics of the lack of colour use in the 19th
century. He believed that artists considered the values of colour more than before,
but were hampered by the restrictive rules of landlords and patrons. Thus he argued
that there was a fear of colour caused by a lack of support from architecture patrons
in accepting the power of colour in life (Düttmann.M 1981).
Among numerous artists who had an influence on the changing views of architectural colour use, Kazimir Malevich and Piet Mondrian contributed to the use of colour in the internal and external built environments through their art. The colour principles of Mondrian affected the selection of primary colours and the rejection of impure colours such as brown in the 19th century (Porter & Mikellides 1976). Interest in theosophy brought the idea of the spiritual content of colours into Mondrian colour philosophy (Gage 1999). Additionally, he believes that architectural colours are able to define the space in addition to their ornamental meaning.

In the late 19th century, colour became the central visual paradigm presented in Impressionist and Symbolist paintings, as well as in some architectural designs (Gage 1999). In *The Language of Colour* Van Leeuwen identifies the Impressionists as a movement that brought back colour into Western art and architecture and ended the “monochrome age” (Van Leeuwen 2011, p. 71). Impressionist artists were influenced by the physicist Hermann von Helmholtz (1855), who claimed that what we perceive of an object is just the effect of the object on our nervous apparatuses, and they still used colours naturalistically but tried to capture the sensation of objects through using painting taches (small coloured shapes which represent nothing on their own) (cited in Gage 1999, p. 206). Accordingly, increasing the importance of colour led to the invention of various colour systems such as those of Munsell and Ostwald in the late 19th and early 20th centuries.

### 2.4.3 COLOUR IN THE 20TH CENTURY

Attempts to create a relationship between artists and architects led to the appearance of a few short-lived movements in the 20th century (Durao 2012). The Art Deco (movement in decorating art and architecture) and Art Nouveau (style of art and architecture) in the early 20th century consider colour a graphical solution and prefer
to use single colour themes to support organic forms in interior spaces (Marisha 2016, p. 17). Moreover, constructivism, Expressionism and Neo-Plasticism or the De Stijl movement believe in colour as a symbol with powerful emotive and subjective essences (Minah 1996). These movements changed the relationship between art and architecture and the approach to the use of colour in architectural design (Porter & Mikellides 1976) through translating abstract and basic shapes and colours into building blocks for product design and architecture (Van Leeuwen 2011). Thus it can be argued that the approaches of these movements, especially the De Stijl movement, resulted in a second paradigm shift in the history of colour in architecture (Prieto 1995).

The Dutch Neo-Plasticist or De Stijl movement (founded in 1917) was a modern movement in the Netherlands based on the abstract painting of Mondrian and it caused an important expansion in the use of colour as a tool in theoretical approaches to architectural form (Minah 1996). The members of this movement, Theo Van Doesburg, Le Corbusier, Gerrit Rietveld and Mondrian, aimed to use colour for the creation of new spatial experiences (Durao 2012). In contrast with previous points of view about colour, the De Stijl movement created a consciousness of the theory of colour and announced it as one of the elements of space. As declared by Van Doesburg, the De Stijl movement returned the primary colours to building facades (Caivano 2005; Porter.T 1982) and “established the true place of colour in architecture” (cited in Koolhaas, Foster & Mendini 2001, p. 253). De Stijl members believed in the power of colour as an element that adds a new dimension to architecture, time and space, and is inseparable from architectural structure. Rietveld’s Schroder House (see Figure 2.21) is a great example of colour use in this movement that tries to emphasise function, create illusion and add a special quality to the space (Porter.T 1982). For the building interior and exterior, he used both
non-chromatic (grey, white and black) and chromatic colours (red, yellow and blue), especially primary colours, for colouring the windows and the supporting girders of balconies.

The De Stijl movement was a remarkable accomplishment in colour use, not only as a design essential but also as a conceptual idea to create a new experience (Minah 1996). Despite the short life of this movement, it had great influence on modern pioneers such as Le Corbusier. Its influence has been utilised more through theory statements and images than concrete buildings (Caivano 2005).

Figure 2.21: De Stijl movement, left image: Schroder House by Gerrit Rietveld; right image: decorative art painting by Piet Mondrian (source: www.tinadhillon.com/the-schroder-house-utrecht-the-netherlands)

In parallel with the appearance of these new movements, the German Bauhaus school (founded in 1919) brought different thinking about the relationship between art, construction and especially the use of colour through considering “what colour could do for form rather than colour as decorative element” (Marisha 2016, p. 17). While Bauhaus adherents recognised the primary colours, white, black and grey as colours that are easy to mass-produce and needed to make the form stand out (Marisha 2016, p. 17), Walter Gropius, one of the masters of modern architecture and the founder of Bauhaus, gave importance to colour studies through his school programs and selection of teachers. In the first Bauhaus manifesto, Gropius writes: “Architects, sculptors, painters, we must all return to craft” (cited in Fiedler 2006, p. 192). Wassily Kandinsky, Paul Klee, Albers and Itten are known as the teachers
who held the first colour workshop to develop the colour course in Bauhaus (Caivano 2005; Kwallek & Stovall 2010). Despite the strong rational approach of Gropius to architecture and art, he allocates some sections to biological facts, illusion and colour psychology in his book *Scope of Total Architecture* (Gropius 1962).

The Deutsche Werkbund Exhibition (1914) and the still-running German Day conference on colour (1919) were the starting point of a debate between the rational view of Ostwald and the subjective view of the German painter and teacher Adolf Höelzel on colour entitled *Norm vs Form*\(^7\) (Gage 1999; Minah 1996). This debate came about through the employment of one of Höelzel’s pupils, Johannes Itten. Itten, as an artist and colour theorist, taught a preliminary course entitled *Vorlehre* through subjective Bauhaus methods and its mystical approach. He was interested in the role of colour in revealing personality. It should be mentioned that his teaching document is still used in teaching of colour theories to architectural students, as summarised in his book *Art of Colour*. Itten’s subjective beliefs often clashed with Gropius’s rational approach and caused him to resign from the school. Other teachers Klee and Kandinsky also taught colour topics distinct from Itten’s *Vorlehre* at the Bauhaus. They offered a new course entitled ‘Imaginative painting classes’ which provided a context to their ideas of colour as a physical, chemical and psychological phenomenon (Gage 1999). For example, Kandinsky explained to his students that their task was to create an “ideal colour box … in which the colours are set in a well-founded order” (cited in Fiedler 2006, p. 397).

In a review of the works and beliefs of the master of modern architecture, Le Corbusier reveals his dialectic architectural nature and how his ambivalence towards

---

\(^7\) ‘Norm’ represents belief in the development and refinement of prototypes in architecture and industrial design, and ‘Form’ represents the creative sovereignty of the individual artist (Reading, Minah).
the interaction between polychrome and monochrome colour approaches caused a
dualism in his career (Riley 1995). In published articles in 1921, 1923 and 1924, Le
Corbusier denies the importance of colour in space-making and believes that the
idea of form precedes colour. Although in his younger days he used abundant colour,
in his architecture he chose purity for his use of colour. Accordingly, he established
Purism and introduced white as the dominant theme of architecture in the 1930s,
which became the characteristic of international style and can also be seen as the
reason for the lack of colour use in the work of some modern architects (Minah
1996). Although he believes that colour may destroy form, he never abandons
colour. The Purists developed a theory of architectural colour through using colour
to “serve as an architectonic rendering mechanism” (Kane 2015, p. 6).

A few years later it seems that Le Corbusier changed his mind about colour
under the influence of De Stijl, which is clearly revealed in his 1931 article on
architectural polychromy (Caivano 2005). His new belief in the power of colour
influenced the use of colour in his architecture (Figure 2.22), such as Pessac
Housing, for emphasising the separation of inside from outside (Porter.T 1982).
According to Van Leeuw en, Le Corbusier used colour pragmatically to influence
the perception of space, for example using specific colours to create a sense of
spaciousness, or to conceal complex arrangements or mistakes (Van Leeuwen 2011,
p. 80).
But the painter-architect Bruno Taut, who was a contemporary of Le Corbusier, is known as the most important colourist of the Modern movement. He was a strong advocate for the use of colour, and amalgamated the rational and social skills of architecture by using highly saturated colours for his designs (Lancaster 1996). He was also the first German architect who used colour successfully as a social identification and communication tool. His Falkenberg housing project of 1915 in Berlin, which was called the Paintbox Settlement, made him a pioneer of the constant colour scheme (Düttmann.M 1981). The findings of a Labour Council of Art survey after the First World War caused him to become concerned about the lack of colour use in public buildings. Accordingly Taut, in his Magdeburg project, used unbroken colours to declare war on its drab streets (Düttmann.M 1981). Moreover, he achieved huge success by selecting a complementary colour scheme for the Onkel Toms Hütte station and Waldsiedlung Zehlendorf district, and giving a colour identity to housing blocks in Prenzlauer Berg (Durao 2012). According to Taut, everything in the world has colour and it is able to underline the character of space so that everything people make must have colour (Lancaster 1996) (Figure 2.22: Heidi Weber Museum, designed by Le Corbusier (source: Roland zh)).
2.23). In this regard, Taut describes colour choice in terms of spatial and emotional effects (Durao 2012).

Although in the post-War era many architects were affected by the power of colour, some did not agree with Taut’s colour scheme. None of these modern architects advocate non-use of colour, but the discussion was about different attitudes toward colours and its applications. Adolf Loos, who was an influential modern European architect, for instance, believes that using any kind of ornament is a crime and colour is no exception. His view was followed by that of another pioneer of modern architecture, Ludwig Mies van der Rohe, whose aphorism is “Less is more”, which resulted in a new approach to architecture and colour use known as Minimalism. But Minimalists did not ignore the importance of colour. Consequently, even the white of the Purist modern architect was intended to allow the chromatics of the landscape to be seen more strongly in contrast with their white or glass architecture (Caivano 2005). Even in organic architecture, which supports the idea of applying natural colour in construction materials, there is no lack of awareness about the value of colour. But we cannot ignore the huge influence of the
The appearance of the Postmodernism movement in the 1970s and 1980s referenced history and the environment. This novel approach brought a new wave of interest in colour in architecture, especially through ignoring the American subculture of restraint on colour by Robert Venturi, whose postmodern aphorism “less is a bore” is an antidote to van der Rohe’s modernist dictum (Minah 1996). The use of colour to make a strong statement in the design of the Georges Pompidou Centre in Paris by Renzo Piano and Richard Rogers alludes to the colours of the natural environment in connecting the building to the ground and showing its growth from the earth. Michael Graves’s works (in the USA) and those of other architects such as Paolo Portoghesi and Aldo Rossi (in Italy) and Mario Botta (in Switzerland) are examples of a new attitude towards colour in the late 20th and early 21st centuries (Caivano 2005).

Although historically colourists mostly engaged in colourful industrial architecture but sombre and uniform residential architecture, after the Second World War arose the need to personalise and give character to residential buildings. In this
sense, the need for buildings to bring improvement to the quality of life and urban renewal, the growth of corporate giants of the entertainment industry in the 1980s and 1990s and the need for service spaces such as urban malls, offices and restaurants all resulted in broadening the definition and role of colourists as a new profession collaborating with architects, increasing the significance of colour design since the 1950s (Linton 2002). To meet all these new requirements, the first multidisciplinary teams consisted of architects, urban planners and colourists who gathered in France in the early 1970s, and this brought colourist into new experimental territory (Linton 2002).

The use of colour in architecture was continued in the 1990s by architects and colourists such as Bernard Tchumi (France), Jean-Philippe Lenclos (France), Shashi Caan, Donald Kaufman and Lois Swirnoff (USA), Michael Lancaster (UK), Leo Oberascher (Austria) and many others. Colour consideration in the late 20th century was not only about colour design for the new built environment, but also encompassed restoration of the historical colour of the urban environment and landscape, which resulted in a new generation of experts in environmental colour design called colour consultants, who worked in collaboration with architects. As there was not any formal educational training about the use of colour in architecture, architects and colourists/colour consultants created new techniques and methods for studying and measuring colour, such as the three steps of the colour study of Lenclos for the design of the Anchorage Color Palette Alaska (analysing the current environmental colour, identifying the colour specification of the area through the NCS and producing a colour palette based on the analysis), and the four steps of the colour study of Lancaster (collecting colour samples (colour face), classifying colours (colour map), creating a colour id (colour palette) and informing the people) (Lancaster 1996) applied to places such as Tokyo, Greenwich village in New York.
Moreover, the method adapted by Porter for designing the colour palette of Oslo, Norway (Porter. T 1997).

In reviewing the history of colour in architecture, the formation of the International Colour Association (AIC) in 1967 and the AIC Study Group on Environmental Colour Design (ECD) in 1982 have promoted colour knowledge and colour research through different disciplines and points of view (AIC 1967; Bergström.B 2002). The EDC is an international group of scientists, urban designers, architects, artists, designers, historians, psychologists and other professionals with a specific interest in colour as a means of environmental design and its effects on humans (Schindler. V. M 2007). Many notable names can be seen among the group members, such as Shigenobu Kobayashi, who developed the colour image scale. His colour method can be used as an essential element of psychological research on colour meanings by linking image words to colour combinations (Kobayashi 1991; Kobayashi & Sato 1977). Oberascher has been working as a colour consultant for decades and has a colour scale model which is applicable to architecture, and Paul Green-Armytage is an expert in the field of teaching colour to design students (Caivano 2005).

2.4.4 COLOUR IN THE 21ST CENTURY

While, the advent of new technologies and building materials and also the new perspective on colour use that began at the end of the 20th century sparked a new approach to colour use, challenges persisted into the 21st century. A review of contemporary architects shows that, although some insist on colourless or transparent materials, it seems that we are confronted with the growth of a new generation open to using bright and bold colours in their designs. Serra (2013b) believes that in the 21st century we are confronting “a noticeable move toward the versatility of color in architecture.” The advent of new
technologies, materials and design tools and techniques are influential factors in this move towards versality, as well as artistic attitudes and changes in the understanding of the discipline. Serra argues that architecture “seems to be caught up in this dynamic of constant renewal,” and that colour use provides opportunity for changing the purpose and appearance of architecture via four concept of versality: transformation, fragmentation, movement, and novelty (Serra 2013b).

Van Leeuwen (Van Leeuwen 2011) and Linton (Linton 2002) believe that the advent of new technologies such as computer-aided design software, which offer a wide range of colour palettes, has changed the way architects make their colour decisions and apply colour to their designs. 3D modelling software such as SketchUp and 3ds Max not only provides an opportunity for architects to render their designs in different colours, but means they can also test their design colour in relation to its context through changing the angle and intensity of light based on the time of day and even the geographical latitude and altitude of the site. Moreover, new technologies of virtual space such as CAVE (computer animation video enhanced) are able to progress the use of colour in architecture a step further via creating an opportunity for architects to walk virtually through their own design spaces and experience the influence of the chosen colour on their designs. Further to technological development, the advent of new materials with diverse colour palettes, improvement of coloured lighting techniques and ability to design smart facades which can change their colour based on the time of day or season or on a specific program have not only increased colour use and diversity options, but also transformed the way of thinking and even attitudes of contemporary architects towards the use of colour in their designs.

Rem Koolhaas believes that after the minimal use of colour in the 20th century, the “comeback time” for colour is now facilitated by new technologies. He
states that “in a world where nothing is stable, the permanence of colour is slightly naive”, which endorses the new approach to colour in the 21st century (Koolhaas, Foster & Mendini 2001, p. 11). This new 21st Century architectural approach may be considered a third paradigm shift in the history of architectural colour. It also should be mentioned that the ubiquity of affordable software and mobile apps which offer diverse colour palettes and new methods for applying colours in 3D models and even pictures of real space has intensified the attention of ordinary people towards the use of colour in their built environments in addition to their own interior spaces, which is reflected in new requirements and expectations from architects. Considering the recent paradigm shift in architects’ and ordinary people’s attitudes towards colour (see, for instance, Figure 2.25), it might be asked – will this change be reflected in future architectural curricula and related professional education programs?

Figure 2.25: Pixel building, design by studio 505Melbourne, 2012

2.4.5 COLOUR USE IN ARCHITECTURAL PRACTICE

The literature on the use of colour in art and architecture dates back to ancient times. Vitruvius’s Ten Books of Architecture [De architectura] (20 BC) is one of the
earliest sources addressing colour use in any field and focuses specifically on architecture. Vitruvius discusses in Book 7 the pragmatics of sourcing natural colours and creating artificial colours, but says little about what might inform colour choice beyond these practical limitations.

Following Vitruvius, Alberti in Chapter 10 of Book 7 of *On the Art of Building in Ten Books* [*De re aedificatoria*]) (1485) argues for purity and simplicity when colour is used for decoration and adorning walls, so that it is “pleasing to the gods above” (Alberti 1988, p.220). This is a more cautious approach to the aesthetic role of colour than the one he takes 17 years later in *On Painting* [*De picture*], where he refers to the affective and emotional values of colour.

Palladio in *The Four Books of Architecture* [*I Quattro Libri dell’Architettura*] (1570) refers to three aspects suggested by Vitruvius “to make a deserved edifice: utility or convenience, duration and beauty” (Book 1, Chapter 4) (Palladio 1965). Palladio discusses colour as one of the features of materials, such as sand and metals, that ought to be considered and prepared before starting to build in order to create beauty that is in correspondence with the form as a whole (Book 1, Chapter 22). He suggests that the diverse colours and forms of brick floors “will be very agreeable and beautiful to the eye” (Palladio 1965, p.150). In his fourth book, on the reconstruction of ancient Roman temples, Palladio studied colour as one of the ornamental aspects of temples and echoes Alberti when saying: “of all the colours, none is more proper for churches than white; since the purity of colour, as of the life, is particularly grateful to God” (Palladio 1965, p.413). Palladio also believes that painting sacred places such as temples is improper, as this would detract from their magnificence.

While Serlio in *Architecture, A Treatise in Seven Books* [*I Sette Libri dell’Architettura*] (1537–75) refers to material selection and use in some of the
books, especially in Book 3 on temples, he does not refer to colour or indeed use the word ‘colour’ in any of the seven books.

Contemporary research on the potential and benefits of colour use can be loosely categorised into three groups: (1) colour use for therapeutic purposes; (2) colour use due to its psychological influence in different contexts, such as healthcare, education and office environments; and (3) colour use in design. There has been much research in the realms of health and wellbeing considering the influence of colour on feelings, moods and behaviour. For instance, Withrow (2004) suggests that the use of colour in art therapy can help clients reach deep into their unconscious thoughts to release their emotions and feelings.

On the psychological influence of colour use, appropriate colour use in different environmental conditions has been considered, such as healthcare centres, elderly care environments (Yu & Yoon 2010) and working spaces. It is suggested that the right choice of colours may help accelerate patient recovery, and might improve performance and productivity in workers, students and athletes (Birren 1978b; Öztürk 2010). There has also been research on the influence of specific colours on human behaviour, performance and wellbeing (Elliot et al. 2007; Yu & Yoon 2010). Hutchings raises the issue of ethics in colour use when asking “can we hurt people through using colour?” (2006, p. 87). He considers the ethics of colour use not only in environmental design and architecture, but also in food, product packaging and marketing (Hutchings 2006).

Finally, a relatively small number of studies have looked at colour use in design. For instance, in her The colour of cities, Swirnoff (2000) focuses on colour use in vernacular architecture and concludes that colour is always one of the main elements of architectural characteristic and culture. She studied the development of local colours as a result of the communities’ response, the “vernacular eye”, to the
environmental features and local habitat over the time. She also examines the relation between colour perception and use in different cities and regions with their geographical features (latitude and longitude) and the angle of sunlight. Accordingly, she categorised cities into three groups: (1) cities/regions of light e.g. Rome, Florence, Bologna; (2) median cities e.g. Paris, New York, Boston; and (3) cities of shadow e.g. London, Stockholm, Copenhagen (Swirnoff 2000). Therefore, she concludes that the relationship between geographical features and light plays a significant role in colour choice and use, as well as cultural factors. Moreover, Swirnoff believes the use of colour in architecture should be considered on different scales: city streets, facades, apertures and the human scale, which contains materials and details.

Similarly, in his theory of the geography of colour, which is based on social sustainability, Lenclos argues that geographical factors have resulted in the expression of different colour palettes in different regions. His study of colour use in eleven countries around the world reveals that, although the selection and use of vernacular colour is often based on similar rules in different locations, the vernacular “gestalt” and expression of colour differ remarkably from place to place according to geographical, religious and climatic conditions (Lenclos 2004). Thus vernacular colour preference is seen to shape the perceptual experience of and to determine national, regional and local place identity. Accordingly, the vernacular colour palette is recognised as a component of the visual and cultural language of any region (Lenclos 2004; Swirnoff 2000). In this sense, the colourscape of a region can be seen to depend on numerous factors, including: geographical situation (latitude and altitude, which define angle and intensity of sunlight); homogeneity of architectural character; climate; natural features; and chromatic expression of a given region or country based on its aesthetic tastes, religious beliefs and other
socio-cultural influences (Lenclos 2004). For example, using building materials and surface finishes of light colours with high reflectivity in a hot desert is based on the need to maximise the reflection of sunlight from surfaces in order to keep dwellings cool, for example the colour of the soil as the dominant colour of many Iranian vernacular desert cities, which are sometimes covered with colourful tiles and paint (Figure 2.26).

![Image of Imam Mosque, Isfahan, Iran](source: Vahid Gheydarlou)

Smith (2003) investigated how important colour is for interior designers and architects. She found a number of factors that may affect the choice of colour by architects: organisational and/or personal colour preference and style; context; building typology; end-user preferences; and innovation.

In the seventh section of their book *Urban Design: Ornament and Decoration* Moughtin and Tiesdell (1999) focus on the use of “colour in the city” as an ornamental and decorative element of urban design. They show how colour can be used to improve the image of a city through highlighting specific buildings and landmarks, colour-coding important paths and giving a specific character to urban environments, especially public spaces (Moughtin, Oc & Tiesdell 1999, p. 144). Similar to Swirnoff, Moughtin and Tiesdell consider colour use on different scales: the scales of the city/district, street or square, individual buildings and details. In this sense, the use of colour on different scales of the city can contribute to a sense of unity, create specific character and mood, change the appearance of aspects such
as street volume and length, and influence the visual functions of building (Moughtin, Oc & Tiesdell 1999, p. 142).

Minah studied colour use in the disciplines of architecture and urban design, highlighting the role of colour not only as a communication tool but also as integral to design in all its stages. He discusses different uses of colour in three phases of the design process: (1) colour dynamics in the conceptual phase, that is, using colour as a communication tool in conceptual drawings to clarify concepts; (2) colour tectonics in schematic/form-making to help in understanding the design, its relation to context and selection of potential materials; and (3) colour imagery in the design development phase. Minah suggests that in the discipline of urban design, colour is mostly used as a communication tool and graphical code to clarify and categorise visual information in different types of documents. He also discusses the use of colour as a tool for recording the experience of space, as well as for showing physical space through techniques such as cognitive maps.

Finally, Serra (2013a) categorises into three main groups the strategies of environmental designers for using colour to express a particular purpose: (1) to influence the perception of the visual properties of architectural shapes such as geometry, dimension of the space/volume, and weight; (2) to describe the building; and (3) to use colour based on its intrinsic value.

In this thesis, colour use in architecture is described as compromising two chief influences: (1) Colour Orientation (which varies little if at all between designs); and (2) Contextual Variables (e.g. the cultural and physical context of a design, the building or building component function, client directives). For elucidating the notion of colour use in more detail, it requires definition. Distinguishing between colour and colourfulness preference, I suggest two aspects of colour use in architectural design: (1) the colours that architects choose for a
design (hue choice); and (2) how colourful the design is (colourfulness), which relates to architects’ personal colour orientation. The differentiation is clear when considering the portfolios of architects, for it is more common that an architect will be known for colourful buildings than for, say, red buildings.

2.5 COLOUR KNOWLEDGE AND EDUCATION IN ARCHITECTURE

Despite the long-held but differing opinions on the importance of colour in architectural design, the literature suggests that colour is rarely a subject of serious enquiry in design practice and education. In the domains of architectural theory and practice, colour is predominantly considered secondary to characteristics such as form, line and structure (Minah 2013) or as a supplemental concern that is largely a matter of personal expression (Durao 2012).

Considering its impact on mood, perception and interpretation, colour ought to have a significant place in the education of architects and urban designers. It might be argued that architects and urban designers, as those responsible for creating high-quality living spaces, should have considerable knowledge of and experience in the use of colour. They should be able to design interior and exterior spaces coloured in ways that alleviate stress and increase comfort. Therefore, adding colour knowledge and understanding to the standard architecture curriculum is an important step towards this goal (Minah 2013).

The following section discusses the findings of a desktop survey of architectural curricula and criteria of course accreditation bodies conducted in the UK (RIBA 2010), Australia (AIAP 2009; NCSA 2008) and Iran (MSRT 2016) in order to determine the place of colour in architectural education based on six particular aspects of architectural practice. It is followed by a review of studies on colour learning and knowledge in architecture based on two particular aspects: colour in architectural curricula and pedagogy in architectural colour education.
To investigate the place of colour studies and understanding in architectural education, the curriculum standards and accreditation requirements of Australian (AIAP 2009; NCSA 2008), British (RIBA 2010) and Iranian (MSRT 2016) architectural education have been examined through the lens of research carried out by Kramer (2012) that aimed to determine the state of social responsibility training in architectural education. But instead of the four aspects of social responsibility discussed by Kramer (sustainability, responsibility to consider the needs of communities and the wider public, ethics and civic engagement through public service), the current research proposes six aspects of social responsibility in architectural practice that can relate to understanding of colour theory and use: (1) sustainability; (2) community needs; (3) ethics; (4) communicative design; (5) cultural context; and (6) responsibility to consider laws and regulations. Although factors number 1, 2 and 3 repeat Kramer’s aspects, the definitions of these aspects have been revised in relation to the focus of this study.

(1) **Sustainability** (Kramer 2012): Considering colour in interior and exterior design with regards to climatic and angular conditions can create more sustainable built environments. Not only can physical sustainability be improved by colour, but social sustainability can also be progressed using colours rooted in people’s memories, culture and identity.

(2) **Community needs** (Kramer 2012): Architects are responsible for considering the various needs and requests of people around their built environment in their designs. Awareness of this responsibility can improve a community’s quality of life by increasing its satisfaction with its living environment.

(3) **Ethics** (Kramer 2012): Architects must be aware of the ethical consequences of their design decisions. Considering sociocultural, environmental and economic issues allows architects to act as responsible professionals.
(4) **Communicative design:** Architects are responsible for creating contact between the community and home-owners. Selection of colour in relation to environmental characteristics and requirements is a tool that can help them to achieve this goal.

(5) **Cultural context:** Architects must consider cultural characteristics and the needs of the context in their designs.

(6) **Responsibility to consider laws and regulations:** Architects must apply local and regional regulations in their designs. Some cities have specific rules for their colourscape that must be considered in architectural designs.

The Australian Institute of Architecture believes that good architectural education nurtures architects who are able to improve the quality of the built environment (AIA 2008). In this regard, the AIA Policy on Tertiary Education of Architects has set standards for architectural education. By studying the release standards, which reveals the AIA’s expectations around architectural education in Australia, the state of colour consideration can be investigated. Table 2.1 lists selected standards which can consider colour in their context and teaching process.
Table 2.1: Selected program content and standards that can include colour as an essential component, based on the Australian Institute of Architecture Policy (AIAP 2009)

<table>
<thead>
<tr>
<th>Program Content</th>
<th>Text of Standard for Programs in Architecture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design studies and integration</td>
<td>Knowledge of and familiarity with material sciences</td>
</tr>
<tr>
<td></td>
<td>Knowledge about various types of inventive architecture</td>
</tr>
<tr>
<td>Documentation and technical studies</td>
<td>Knowledge about building materials and component systems for improving sustainability, for example, through developing thermal comfort</td>
</tr>
<tr>
<td>History and theory studies</td>
<td>Awareness of architectural history and theory</td>
</tr>
<tr>
<td></td>
<td>Awareness of heritage issues and conservation</td>
</tr>
<tr>
<td></td>
<td>Doing architecture in relation to historical and cultural background</td>
</tr>
<tr>
<td>Practice and project management</td>
<td>Awareness of professional ethics and conduct codes in architectural practice</td>
</tr>
<tr>
<td></td>
<td>Responsibility to consider social context and users' needs in designing a built environment</td>
</tr>
<tr>
<td></td>
<td>Responsibility to consider codes and standards in built environment design</td>
</tr>
<tr>
<td>Environmental studies</td>
<td>Awareness of social and cultural dimensions of place</td>
</tr>
<tr>
<td></td>
<td>Knowledge and awareness of sustainability issues</td>
</tr>
<tr>
<td></td>
<td>Awareness of national and regional planning issues and their relationship to global and local resources</td>
</tr>
<tr>
<td></td>
<td>Familiarity with inactive methods for providing thermal comfort, light etc.</td>
</tr>
<tr>
<td>Communication skills</td>
<td>Communication of design concepts and ideas through the skills of drawing, modelling etc.</td>
</tr>
</tbody>
</table>

The Architects Accreditation Council of Australia (Wise & Wise) in conjunction with the Royal Australian Institute of Architects (Wise & Wise) is responsible for facilitating the competency-based assessment (CBA) process and maintaining the National Competency Standards in Architecture on behalf of the profession (NCSA 2008). Extracts from these documents are organised into four units of competency: design, documentation, project management and practice management, with 149 evaluative statements about performance criteria. Table 2.2
lists a selection of the performance criteria which can include colour and the five aspects of architecture of which colour is an essential part.

Table 2.2: Selected content of Australian Architectural Requirements for Accreditation that can include colour as an essential component, extracted from the NCSA National Competency Standards (copyright of this material is owned by the Architects Accreditation Council of Australia (AACA)) (NCSA 2008)

<table>
<thead>
<tr>
<th>Criterion #</th>
<th>Text of Performance Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>02</td>
<td>Urban or rural location context should be considered in design concept</td>
</tr>
<tr>
<td>07</td>
<td>Social, cultural and environmental issues should be considered in design concept</td>
</tr>
<tr>
<td>09</td>
<td>Natural environment and sustainability issues should be considered in design concept</td>
</tr>
<tr>
<td>10</td>
<td>The graduate should consider the project impact on users and community in design concept</td>
</tr>
<tr>
<td>12</td>
<td>The observation of society values which influence health, safety, welfare and use of the built environment should be represented in design concept</td>
</tr>
<tr>
<td>13</td>
<td>The graduate should consider ethical basis, laws and statutes that regulate the practice of architecture in design concept</td>
</tr>
<tr>
<td>14</td>
<td>The industry standards for development, design, law, relevant codes and regulations should be represented in design concept</td>
</tr>
<tr>
<td>21</td>
<td>Human, social, environmental and contextual issues should be considered in design concept</td>
</tr>
<tr>
<td>25</td>
<td>The researched issue, experiential, material and aesthetic options should be demonstrated in schematic design</td>
</tr>
<tr>
<td>43</td>
<td>The graduate should consider visual and contextual qualities of the construction elements, materials and building component in detailed designs</td>
</tr>
<tr>
<td>91</td>
<td>The graduate should have knowledge and awareness of environmental factors</td>
</tr>
<tr>
<td>92</td>
<td>The graduate should have knowledge and awareness of cultural factors</td>
</tr>
<tr>
<td>149</td>
<td>The graduate should have awareness of professional ethics and ethical practice</td>
</tr>
</tbody>
</table>

In the UK, the Royal Institute of British Architects (Feisner) published the validation criteria as accreditation requirements to establish a benchmark for standards in architecture education (Feisner 2000; Royal Institute of British Architects. RIBA 2010). The purpose of accreditation criteria is to ensure students are aware of the
impacts of their design projects and decisions on the quality of the environment and communities. Table 2.3 lists a selection of criteria in which colour can have a place.

Table 2.3: Selected content from RIBA accreditation criteria which can include colour as an essential component
(Royal Institute of British Architects. RIBA 2010)

<table>
<thead>
<tr>
<th>Criterion #</th>
<th>Text of Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>GC1</td>
<td>The graduate will have the ability to create a design which can provide aesthetic satisfaction as well as technical requirements</td>
</tr>
<tr>
<td>GC2</td>
<td>The graduate will have sufficient knowledge of cultural and social backgrounds which have an influence on a design</td>
</tr>
<tr>
<td>GC3</td>
<td>The graduate will have adequate knowledge of the fine arts and their impact on design quality</td>
</tr>
<tr>
<td>GC4</td>
<td>The graduate will have awareness of the influence of the design and development of cities on the contemporary built environment and current planning policy and development control legislation, including social, environmental and economic aspects, and the relevance of these to design development</td>
</tr>
<tr>
<td>GC5</td>
<td>The graduate will have understanding of users’ and community needs, sustainable design, the impact of their design and its coordination with local context</td>
</tr>
<tr>
<td>GC6</td>
<td>The graduate will have awareness of their duties and responsibility as an architect and the impact of their design on communities</td>
</tr>
<tr>
<td>GC9</td>
<td>The graduate will have knowledge of the principles associated with designing optimum visual, thermal environments</td>
</tr>
<tr>
<td>GC11</td>
<td>The graduate will have awareness of their fundamental legal, professional and statutory responsibilities, including land law, development control, building regulations and health and safety legislation</td>
</tr>
</tbody>
</table>

In Iran, the Ministry of Science, Research and Technology is the institution that releases the curriculum standards and accreditation requirements. The purpose of accreditation criteria and curriculum standards is to educate architects who have the necessary knowledge and skills to be able to conduct design projects and remain aware of the impacts of their decisions on the quality of the environment and communities (MSRT 2016). However, the listed expectations of architectural students do not contain any statement which relates to any of the six identified aspects (Table 2.4).
Table 2.4: Selected content from MSRT accreditation criteria and standards

<table>
<thead>
<tr>
<th>Criterion #</th>
<th>Graduate role and expected skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The graduate will have the ability to create a design from the early stages to the implementation stage which can provide aesthetic satisfaction as well as technical requirements</td>
</tr>
<tr>
<td>2</td>
<td>The graduate will have sufficient knowledge to work collaboratively with other scholars such as ecologists, economists and social planners</td>
</tr>
<tr>
<td>3</td>
<td>The graduate will have adequate knowledge to be a member of technical and municipal policymaking teams or at other management levels</td>
</tr>
<tr>
<td>4</td>
<td>The graduate will have the ability to consult in the field of built environment design, especially in their area of expertise</td>
</tr>
<tr>
<td>5</td>
<td>The graduate will have awareness of their fundamental legal, professional and statutory responsibilities, including land law, development control, building regulations</td>
</tr>
<tr>
<td>6</td>
<td>The graduate will have awareness of society needs, cultural context and vernacular architectural design</td>
</tr>
</tbody>
</table>

Table 2.5 summarises the consideration of selected aspects of architectural practice which can include colour in Australian, British and Iranian accreditation criteria and architectural standards programs.

Table 2.5: Validation of selected architectural practice aspects in standard and accreditation organisations

<table>
<thead>
<tr>
<th>Country</th>
<th>Organisation or institute</th>
<th>Sustainability</th>
<th>Community needs</th>
<th>Ethics</th>
<th>Communicative design</th>
<th>Cultural Context</th>
<th>Responsibility to laws and regulations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>AIA</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>_</td>
</tr>
<tr>
<td></td>
<td>AACA</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>_</td>
<td>_</td>
<td>✓</td>
</tr>
<tr>
<td>UK</td>
<td>RIBA</td>
<td>✓</td>
<td>✓</td>
<td>_</td>
<td>_</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Iran</td>
<td>MSRT</td>
<td>_</td>
<td>✓</td>
<td>_</td>
<td>_</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Chapter 2: Literature Review

In conclusion, a review of the accreditation criteria and standards of architecture education reveals that none of these documents contains a statement that considers colour directly. While learning in relation to the majority of these six contexts is clearly required for Australian, British and Iranian accreditation (Table 4), none of the accreditation documents of the three bodies names colour as a required area of study. Furthermore, a detailed study of Australian and Iranian curricula (at bachelor, master’s and PhD levels) reveals an almost total absence of adequate colour training in the majority of built environment degree programs.

2.5.1 STUDIES OF COLOUR IN ARCHITECTURAL EDUCATION

A review of the literature reveals that, although much research has been conducted in the field of colour, only a few studies have focused on colour in architecture and built environments, and even fewer have considered colour learning and training in architectural education. The following presents an overview of the theoretical background of the studies which have been carried out to identify the place of colour study in architects’ knowledge and awareness and architectural design.

As stated in Section 2.4, Bauhaus school practitioners of education Itten, Klee, Kandinsky and Albers were pioneers in offering the first colour courses to their students and raising the importance of colour education (Kwallek & Stovall 2010). Despite their attempts to improve colour education, this review of the literature and desktop survey of architectural curricula and the criteria of course accreditation bodies in the UK, Australia and Iran has revealed a lack of consideration of colour in architectural education, which may result in a lack of confidence or even fear around the use of colour in architectural design and practice.

In Interaction of Colour Albers (1963) introduces a practical way of teaching and studying colour by suggesting the use of colour papers as a source for colour recognition and classification (Albers 2006). The colour paper method is one of the
most efficient methods in improving the ability of observation and capturing the colour seen in colour papers, and has been used in colour studies by different scholars such as Lenclos. Albers also raises the issue of contextual effects on colour perception and ascribed some meanings and feelings to colours. Itten influenced art and design education through his theories and point of view about colour (Feisner 2000; Gage 1999; O’Connor. Z 2008).

Colour in education has been studied through different lenses in various disciplines, such as neuroscience, psychology, linguistics and education. Many studies have considered colour as a pedagogical aid that can improve learning processes. For instance, Daggett et al. (2008) state that colour in learning environments is able to improve students’ attention domain and focus on their learning, while Gheyasi’s (2012) study of fifth grade students in Iran reveals that colour in teaching environments and its direct use in teaching can improve students’ academic achievement.

In the fields of psychology, medicine and health, researchers have investigated: colour cognition (Davidoff & Mitchell 1993), the impact of congenital colour vision deficiency (Cumberland, Rahi & Peckham 2004), colour knowledge in patients with semantic dementia (SD) (Timothy et al. 2007) and training in colour awareness to positively affect mood, behaviour and wellbeing in adults with mental health problems (Parkes & Volpe 2013). Yet colour has rarely been a subject of serious enquiry in design practice and education. The small number of studies on colour learning and colour knowledge in architecture have considered two broad aspects: curriculum and pedagogy.

2.5.1.1 **COLOUR IN ARCHITECTURAL CURRICULA**

A discussed above, desktop survey of architectural curricula and criteria of course accreditation bodies in the UK (RIBA 2010), Australia (AIAP 2009; NCSA 2008) and Iran (MSRT 2016) has revealed an absence of adequate colour training in the majority
of architectural schools in these locations. Batchelor argues that a lack of colour teaching in architectural curricula is a consequence of chromophobia, which is rooted in a lack of confidence in or even fear of using colour in architectural practice and design. Janssens and Mikellides (1998) examined colour training in the curricula of Swedish and UK architecture undergraduates, asking students what they knew “about perceptual and psychophysiological aspects of colour, colour nomenclature, existing myths and beliefs, and how colour is used in their everyday work in studios” (Janssens & Mikellides 1998, p.328). Despite the strong backgrounds of both countries in colour research and colour system creation, a deficiency of colour knowledge was found, with complaints from the cohorts “about a lack of coverage of the subject area in lectures, seminars, or studio work, with very little theory and only few practical exercises” (Janssens & Mikellides 1998, p.328). Although the Janssens and Mikellides study is a cross-cultural one, cross-cultural differences are not discussed by them.

Minah has discussed the ethics of colour use (2013) in relation to how it is taught in the curricula of architectural institutes. In line with Durao (2012), he argues that colour in architecture education is presented as secondary to other architectural characteristics. As a result, he argues that in contemporary cities colour is used largely for high visibility, in comparison to old cities where colour creates a distinctive fabric and visual unity. Thus Minah suggests the teaching of altruistic colour use should be added to architecture curricula. He has also considered the lack of colour knowledge among architects to be a result of its relegated place in curricula. In 1996 he conducted a historical review of architects’ attitudes towards colour use and recognises a lack of colour knowledge and challenges in bringing colour theory into practice as important factors that influence architects’ colour choice and use (Minah 1996).
A number of researchers have offered pedagogical solutions for improving colour knowledge in architecture. For instance, O’Connor (2010) believes that revising approaches to colour teaching, avoiding current ambiguity and confusion in colour theory and colour knowledge communication, and absorbing colour theories from other knowledge domains can improve the willingness of architectural schools to teach colour.

Kwallek and Stovall (2010) designed an interdisciplinary model for teaching colour to first-year undergraduate architecture students through both theoretical and experimental courses. The Living Colour model consisted of four units: (1) pigments and dyes; (2) colour coding; (3) living colour and light; and (4) colour in the built environment. The Kwallek–Stovall model seeks to increase student awareness, from the beginning of their study, of their professional responsibility for the effects of their colour choice on society (Kwallek & Stovall 2010). The result of offering this course shows that it has been successful in improving student knowledge and awareness of colour through the perspective of different disciplines and engaging students in experiencing colour. In order to deal with the multidimensional characteristics of colour, courses have been taught by scholars from different disciplines, such as anthropology, physics and fine arts.

Similarly, in her 2009–2012 study in three European design schools, Vezzani suggests a toolkit, the Colour Design Edu. System (CDES) (Vezzani 2013). Testing of the CDES toolkit, which consists of two sets of cards, reveals that it can support students’ colour knowledge through three stages of opportunity: (1) personal investigation and research; (2) starting dialogue and finding common language with other disciplines; and (3) organising information through design.
Moreover, Ralf and Kanthak (2017) designed a three-week course for teaching colour to landscape architects students at the University of Dresden. Instead of proceeding from theory to practice, their colour course developed based on the experience of practice and individual intuitive analysis to build an understanding of theoretical principles of colour theory. The course starts by familiarising students with colour as a material, followed by analysing colour in nature and architectural surfaces, and finally investigating various connections between colour and other spatial aspects such as texture, light, and spatial geometry. The result of offering this course shows that it has been successful in improving student knowledge and understanding of colour from basics to advanced level through personal experience and practice over the past five years.

2.6 SUMMARY OF THE LITERATURE REVIEW

This chapter has opened with a brief overview of different aspects of the phenomenon of colour and also its influence on people and built environments. A number of studies have identified physiology, psychology and culture as influential factors on individuals’ colour choices. While there is a wealth of research on the phenomenon of colour in different disciplines, little research has been done in the discipline of architecture and, among these, there is limited research addressing colour in architectural education. Considering the significant effects of colour on human psychology, physiology and relationships with built environments, there is a large gap in knowledge about what really informs architects’ colour choice, the reasons behind architects’ colour preferences and use in their designs, and how much knowledge architects have about colour and its use in architecture. This raises further questions: are architects’ colour decisions influenced by their academic or practical experience, or do their cultural backgrounds, personal attitudes and preferences also play important roles?
Chapter 2: Literature Review

In a move towards addressing this knowledge gap, the history of colour in architecture has been examined. The findings of this review have revealed the appearance of three major paradigm shifts, not only in philosophical approaches to colour, but also in artists’ and architects’ attitudes towards and decisions about colour use in their designs. The final shift aided by advancements in technology has seen increased freedom in the use of colour in cities in the 21st Century. However, a review of accreditation criteria and standards of architecture education in Australia, the UK and Iran has revealed an almost total absence of adequate colour training in the majority of built environment degree programs. The findings of this review argue for the importance of colour study in architectural education and the identification of influential factors on architects’ colour decision-making. According to the findings of this review, four factors should be considered influential factors in architects’ colour choice: (1) colour knowledge and education; (2) cultural background; (3) colour orientation (preference and attitude); and (4) practical experience in colour use. To identify the level of influence of these factors on architects’ colour decisions, the next chapter, discusses the methods used to achieve the aims of the research.
CHAPTER 3: METHOD
CHAPTER 3 – METHOD

3.1 INTRODUCTION

To answer the primary research question of this thesis – What informs architects’ colour choices? – a mixed-methods approach has been adopted using qualitative and quantitative data collection and analysis techniques both in parallel and sequentially. Thus in 2014 a 120-item pilot survey was designed and distributed among two groups of participants in Victoria, Australia: (1) postgraduate higher degree by research architectural students; and (2) academics and practising architects. Based on the qualitative and quantitative data from the pilot survey, hypotheses and research questions were revised to inform the final survey. The final 85-item survey of 274 architects, architectural academics and postgraduates in Australia and Iran addressed the question: To what extent do design education, colour knowledge, architects’ cultural influences and personal colour preferences, and contextual factors (such as client preferences and the cultural and physical contexts of designs) inform architectural colour use?

In developing the instrument, the structure of Janssens and Mikellides’ (1998) survey was used, but as very few studies in the field of colour use in design have used surveys, the thesis instrument is almost entirely novel. Indeed, as no study has previously sought to answer the question of what informs architects’ colour choices, the methods used have had to be developed with few methodological precedents. As such, while the process used to develop the method was planned, the process itself has been exploratory and reflective so that the data collection, hypotheses and methods of analyses have been refined up until the results-interpretation phase of the thesis.

This chapter presents the method via its five main constituent phases (Figure 3.1): (1) pilot survey; (2) instrument refinement; (3) final survey; (4) variable
refinement; and (5) selection of analysis methods. Thus the chapter follows this structure, with the addition of a sixth summarising section (Section 3.6). The pilot survey section firstly describes the procedure of survey preparation for ethics approval and invitation of participants. Secondly, it introduces the participants and describes the pilot survey, the procedure of implementation and data collection. Finally, it illustrates the results of the pilot survey data analysis. While it is not common to present results in a method chapter, the pilot results are discussed here because of their role in informing the final survey. The second section of this chapter explains the procedures used to refine the final survey via the pilot results. The third section discusses the final survey design and preparation for ethics approval, selection and invitation of participants, and refinement of the research hypotheses. The fourth section of the chapter describes how the variables were isolated from the final instrument. It also explains how different quantitative and qualitative methods were chosen in line with the aims of the study. Finally, the chapter closes with a summary of how the chief components of this method chapter inform the structure of the results chapter that follows.
Chapter 3: Method

Phase 1: Pilot Survey
Ethics Approval
Participants
Victoria, Australia
Postgrad Students
Academics/Practitioners

Phase 2: Refining the Instrument
Check with Hypotheses
Review of Results
Check with research Question

Phase 3: Final Survey in Iran & Australia
Postgrad Students
Academics & Practitioners

Phase 4: Themes
Identified & Selected Variables

Demographic
- Age
- Gender

Education
- Colour knowledge
- Thoroughness of colour theory education
- Thoroughness of colour practice (in design) education
- Perceived impact of education on knowledge
- Perceived impact of colour knowledge on colour use

Culture
- Country of practice
- Country of childhood
- Primary country of education
- Cultural potency of colour
- Perceived impact of cultural background on colour use

Colour Orientation
- Colourfulness preference
- Colourfulness attitude
- Perceived impact of attitude on colour use
- Perceived importance of colour to architecture
- Importance of colour to built environment

Colour Preference
- Perceived importance of colour to architecture

Practice
- Colour Consultant
- Design Portfolio
- Interior Designer
- Context
- Client
- LPA

Phase 5: Quantitative Methods
- Multiple Regression
- Pearson Correlation
- Chi square & Cross tabs
- Factor analysis
- One sample T-Test
- Paired Sample T-Test
- Independent sample T-Test

Qualitative Methods
- Grounded Theory

Summary

Figure 3.1: The framework of chapter 3-Research method.
3.2 PILOT SURVEY

Two versions of the pilot survey (one for students and the other for academics and practising architects) were administered in architectural schools and architectural practices in Victoria, Australia, to investigate the appropriateness of the survey questions to the research aims and hypotheses. Thus, the pilot survey was used to identify any difficult terms or ambiguous questions in order to improve the quality and clarity of the information in the final survey. The instrument was an online survey circulated in 2014 through <www.Questionpro.com>. Items in the survey were informed by a literature review on what influences designers’ colour choices. As noted, the survey instrument was informed by the Janssens and Mikellides (1998) study. While that survey was composed of six blocks plus a comments section, the pilot survey has nine blocks in three sections, as summarised in Table 3.1. Sections I and III of the pilot largely repeat the overall structure of Janssens’ instrument. Here, some questions are reused word-for-word from the Janssens instrument, some are reworded and some are informed by the ideas discussed in the findings of the Janssens and Mikellides (1998) study (Table 3.2).
**Chapter 3: Method**

Table 3.1: Structure of pilot questionnaire (contents informed by Janssens and Mikellides (Janssens & Mikellides 1998) marked with *)

<table>
<thead>
<tr>
<th>Blocks</th>
<th>General content</th>
<th>Factors/Themes</th>
<th>Type of Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section I</td>
<td>Block 1</td>
<td>Personal demographic* Educational background*</td>
<td>..........</td>
</tr>
<tr>
<td>Block 2</td>
<td>What you think you know about colour?</td>
<td>Personal background &amp; ability</td>
<td>Knowledge &amp; education</td>
</tr>
<tr>
<td>Block 3</td>
<td>What you actually know about colour?</td>
<td>Experience in practice</td>
<td>Multi-choice questions (Likert scale)</td>
</tr>
<tr>
<td>Block 4</td>
<td>Source of your general colour information*</td>
<td></td>
<td>Environmental &amp; human needs Policies &amp; customs</td>
</tr>
<tr>
<td>Block 5</td>
<td>Detail question about colour theory and use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Section II</td>
<td>Block 6</td>
<td>Source of colour research information and knowledge* Preferred source for colour research information*</td>
<td></td>
</tr>
<tr>
<td>Block 7</td>
<td>What is expected from colour research*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Block 8</td>
<td>Expectations from colour education*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Block 9</td>
<td>Suggestions about colour education</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3.2: List of questions informed by Janssens and Mikellides (1998) instrument

<table>
<thead>
<tr>
<th>Section/Block</th>
<th>Janssens and Mikellides (1998) instrument</th>
<th>Exact repeat</th>
<th>Reword</th>
<th>Idea</th>
<th>Current survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section I B-1</td>
<td>At what stage in the design process colour became an important aspect?</td>
<td></td>
<td>✔️</td>
<td></td>
<td>Q1.13 When colour has been an important element of your design, what are some of the reasons that have informed this importance?</td>
</tr>
<tr>
<td>Section II B-3</td>
<td>Who should be responsible for colour design in the built environment?</td>
<td></td>
<td>✔️</td>
<td></td>
<td>Q 2.26 Who is most responsible for colour choices in our built environment?</td>
</tr>
<tr>
<td>Section III</td>
<td></td>
<td>Q 3.3.8 Who should make decision for city about architectural use of colour?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-9</td>
<td>Ask questions to test the actual knowledge of students about NCS system.</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-6</td>
<td>Research on colour psychology is rather meaningless since colour is mostly a matter of taste.</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-7</td>
<td>Too much knowledge of colour and colour research may hamper the designer's creativity.</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-8</td>
<td>Is it possible to reduce the perceived size of a room by painting it with dark colours?</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-6</td>
<td>Do objects painted in light colours feel less heavy than objects painted in dark colours?</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-6</td>
<td>Questions about source of colour research information.</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-7</td>
<td>Which problems or questions colour research should try to solve?</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Section II of the pilot is an additional series of questions on the level of participants’ knowledge about colour and the factors that inform their colour
choices. In total, the pilot survey has 84 items for professionals and academics, and 80 items for students, including 24 (5-point Likert-scale) questions asking participants to rate their colour knowledge, plus open-ended questions seeking elucidation after each block of Likert-scale questions. Table 3.3 summarises the survey in a schematic diagram. The first section of the survey includes multiple types of questions about participants’ personal and educational demographics. The second section ascertains the level of participants’ knowledge of colour and examines the impact of four factors on participants’ colour understanding and use: (1) personal background and ability; (2) knowledge and education; (3) experience in practice; and (4) environmental and human needs. These factors have been drawn from the literature as those that may influence colour understanding. In this section, participants were asked to rate using two different forms of 5-point Likert scales: (1) from 1 = Not at all to 5 = Very important; and (2) from 1 = Strongly disagree to 5 = Strongly agree. These questions are followed by further open-ended questions allowing for qualitative answers expanding on issues raised. Finally, the third section questions participants’ expectations regarding colour research and education, and concludes with space for their further suggestions and comments.
Table 3.3: Schematic table of survey

<table>
<thead>
<tr>
<th>Section I</th>
<th>Part 1</th>
<th>Multi choices Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part 2</td>
<td>Yes and No + Open Ended Questions</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section II</th>
<th>Factors/Themes</th>
<th>Micro Factors</th>
<th>Multi choices Questions + Open Ended Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal Background &amp; Ability</td>
<td>Personal Opinion</td>
<td>Personal Background</td>
<td>Preference in relation to personal background</td>
</tr>
<tr>
<td>Knowledge &amp; Education</td>
<td>Educational learning effect</td>
<td>Responsibility</td>
<td></td>
</tr>
<tr>
<td>Experience in Practice</td>
<td>Personal Preference in relation to personal opinion and experience</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental &amp; Human Needs</td>
<td>Environmental Parameters</td>
<td>Human Needs</td>
<td></td>
</tr>
<tr>
<td>Policies &amp; Customs</td>
<td>External Power and colour choices</td>
<td>Effective factors on colour choices</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Section III</th>
<th>Part 1</th>
<th>Multi choices Questions</th>
<th>Expert</th>
<th>Above Average</th>
<th>Average</th>
<th>Below Average</th>
<th>Don’t Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part 2</td>
<td>Multi choices Questions</td>
<td>Strongly Agree</td>
<td>Somewhat Agree</td>
<td>Somewhat Disagree</td>
<td>Strongly Disagree</td>
<td>Don’t Know</td>
<td></td>
</tr>
<tr>
<td>Part 3</td>
<td>Open Ended Questions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.2.1 PROCEDURE (PILOT)

This section describes the survey preparation for ethics approval and explains how participants were invited to participate.

3.2.1.1 ETHICS APPROVAL (PILOT)

Ethics approval was obtained from Deakin University Human Research Ethics Advisory Group (HEAG). The pilot survey was approved as a low-risk application, on 21 November 2014, to be circulated among postgraduate architecture students, academics and practising architects in Victoria, Australia (Project ID STEC-44-2014-MOTAMED).

3.2.2 PARTICIPANTS (PILOT)

As use of colour by architects and the role of education in informing this use are the primary subjects of the research, the pilot survey was circulated to two groups: architecture postgraduates, and academics plus practising architects. Permission was
sought from heads of schools of architecture in Victorian universities to circulate an email invitation to students and academics. Practitioners were selected through two methods: (1) those who have previously been involved with teaching/learning and research projects with Deakin; and (2) those who work in architectural firms located in Victoria.

From the 55 questionnaires that were distributed, 33 completed questionnaires were received. The gender distribution shows a marked discrepancy between the two groups, with more men (76%) than women (24%) in the cohort of architects and academics, and more women (82%) than men (18%) in the postgraduates. The data shows that both genders demonstrated generally similar responses on the importance of colour in architecture. 100% of women saw colour as ‘very or moderately important’ (M=4.5, SD=3.6), with a small difference for men – of whom 92% saw colour as ‘important’. Only 8% chose ‘somewhat important’ for the level of colour importance (M=4.3, SD=3.2), with no respondents seeing colour as ‘unimportant’ to architecture. The ages of respondents varied, with 70% in the age range of 31–50, meaning most had considerable experience in the study and/or practice of architecture.

3.2.3  PILOT SURVEY – DETAILED DESCRIPTION

Section I of the survey includes multiple types of questions, 18 in total for professionals (architects plus academics) and 17 for students, divided into three parts, to establish participant demographics and educational background in colour study and use in architecture. The first part consists of 9 questions on age, gender, occupation and cultural/educational background. The second part consists of 8 questions requiring yes/no answers, each followed by open-ended questions and one Likert-scale question (Table 3.4), while the professional survey has one extra open-ended question: What do you consider to be the most significant events and
influences in the design history of the city in which you work that have impacted the use of colour there in the built environment? The qualitative questions allow for information about educational background and personal viewpoints about colour in architecture.

**Table 3.4: Sample question of second part of Section I**

| 1.10 Did you study any course at university related to the use of colour in design? |
|-----------------------------------|----------------|
| Yes                              | No             |

1.10.1 If YES please state the course name? And what have you studied about colour in that course?

…………………………………………………

1.11 The higher education that I received in colour theory was thorough.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
</tbody>
</table>

The third part of section I asks participants to rate different characteristics of architecture on a 5-point scale from 1 = Very important to 5 = Not at all. This question aims to elucidate the importance of different characteristics of architecture in relation to colour (Table 3.5), followed by a comment section that allows respondents to add other characteristics not listed in question 1.15.

**Table 3.5: Preview of third part of Section I**

<table>
<thead>
<tr>
<th>1.15 Rate the importance of the following characteristics to your design priorities</th>
<th>Not at all</th>
<th>Minimally important</th>
<th>Some-what</th>
<th>Moderately important</th>
<th>Very important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>Reflectivity</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>Functionality</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>Form</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>Ornament</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>Materiality</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>Tectonics</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>Vegetation</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>Relation with nature</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>Texture</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>Colour</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
</tbody>
</table>
Section II of the survey, with 35 questions for professionals and 32 questions for students, was designed to determine participants’ experience and knowledge of five factors influencing colour understanding and use: (1) personal background and ability; (2) knowledge and education; (3) experience in practice; (4) environmental and human needs; and (5) policies and customs. Two types of questions are asked in this section. The first asks participants to rate their overall knowledge and understanding of colour on two types of 5-point Likert scale (from 1 = Not at all/Don’t know to 5 = Very important/Expert). The second asks open-ended questions expanding on issues raised in the section (Table 3.6).

**Table 3.6: Sample questions from Section II**

<table>
<thead>
<tr>
<th>Please rate your answer from 1 to 5</th>
<th>Don’t know</th>
<th>Below average</th>
<th>Average</th>
<th>Above average</th>
<th>Expert</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1 How do you rate your knowledge of the use of colour in architecture?</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>2.2 How important do you think the use of colour is in architecture?</td>
<td>Not at all</td>
<td>Minimally important</td>
<td>Somewhat</td>
<td>Moderately important</td>
<td>Very important</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
</tbody>
</table>

- What informs you rating like that in Q2.2 above? ………………………………………………………………………………………………..

As the students might not have enough, or any, experience in practice (outside university), the professional survey contains three extra questions related to professional experience and knowledge (Table 3.7).

**Table 3.7: Three extra questions in professional survey**

<table>
<thead>
<tr>
<th>Please rate your answer from 1 to 5</th>
<th>Not at all</th>
<th>Minimally important</th>
<th>Somewhat</th>
<th>Moderately important</th>
<th>Very important</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.20 How important is the night-time appearance of buildings to your colour decision making?</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>2.21 Please explain how your colour choice might be informed to reflect night-time appearance? ………………………………..</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.25 How do you rate the impact of heritage and conservation restrictions on your use of colour?</td>
<td>Not at all</td>
<td>Minimally important</td>
<td>Somewhat</td>
<td>Moderately important</td>
<td>Very important</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
</tbody>
</table>
Section III consists of 31 questions divided into three parts. The first asks participants to rate (on a 5-point scale from 1 = Expert to 5 = Don’t know) their level of knowledge and familiarity with 16 terms relating to colour theory, with space to add a short description of the term (Table 3.8).

Table 3.8: Sample from question 3.1 in Section III

<table>
<thead>
<tr>
<th>Q.No</th>
<th>Words</th>
<th>Don’t know</th>
<th>Below average</th>
<th>Average</th>
<th>Above average</th>
<th>Expert</th>
<th>Write a short description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1.1</td>
<td>NCS</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td></td>
</tr>
<tr>
<td>3.1.2</td>
<td>Colour theory</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td></td>
</tr>
</tbody>
</table>

The second set of questions asks participants to rate their level of agreement with statements about colour use on a 5-point scale from 1 = Strongly agree to 5 = Don’t know). The Janssens and Mikellides (1998) survey was used to inform these statements (Table 3.9).

Table 3.9: Sample from question 3.2 in Section III

<table>
<thead>
<tr>
<th>Qs.No</th>
<th>Statements</th>
<th>Don’t know</th>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.2.2</td>
<td>Particular colours have the ability to influence the perception of room size</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
</tbody>
</table>

The final part of Section III includes 9 open-ended questions designed to elicit qualitative answers (Table 3.10). Two questions (question 3.3.5 and 3.3.8) are asked according to the participants (students or academic/professional architects).

Table 3.10: Sample of open-ended questions, Section III, part 3

<table>
<thead>
<tr>
<th>3.3.2</th>
<th>Can you name any article or author in the field of colour study?</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.3.5</td>
<td>Student survey</td>
</tr>
<tr>
<td></td>
<td>What did/did you expect from academic education in learning about colour?</td>
</tr>
<tr>
<td></td>
<td>Professional survey</td>
</tr>
<tr>
<td></td>
<td>What kind of colour information or training do you feel students of architecture need?</td>
</tr>
<tr>
<td>3.3.8</td>
<td>Student survey</td>
</tr>
<tr>
<td></td>
<td>What kind of colour information is necessary to receive in architectural education that can be useful for your design practice?</td>
</tr>
<tr>
<td></td>
<td>Professional survey</td>
</tr>
<tr>
<td></td>
<td>This is a pilot survey. How do you think its design could be improved e.g. does it ask the right questions?</td>
</tr>
</tbody>
</table>
3.2.4 RESULTS AND DISCUSSION (PILOT)

The following sections (3.1.5 to 3.1.7) report analyses of the quantitative and qualitative data from 24 questions of the pilot survey directly related to the research question: What informs architects’ understanding and use of colour?” Thus, the questions reported are those on the roles of design context, colour knowledge and higher education in informing colour choices. Table 3.11 shows the location of selected questions in a schematic diagram of the pilot survey. Grounded theory was used as a codifying method to reveal the major themes from participants’ comments. Unlike the Janssens and Mikellides (1998) study, statistical testing of comparison of variance was not used due to the small sample size.

Table 3.11: Schematic table of 24 selected survey questions

<table>
<thead>
<tr>
<th>No #</th>
<th>Parts of Sections</th>
<th>Type of Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Part 1</td>
<td>Open-ended + Yes/No Questions</td>
</tr>
<tr>
<td>2</td>
<td>Part 2</td>
<td>Multi-choice Questions (5 Likert Scale)</td>
</tr>
</tbody>
</table>

3.2.5 COLOUR KNOWLEDGE AND COLOUR USE

Likert-scale questions examined colour knowledge and understanding in four areas: (1) personal background and ability; (2) knowledge and education; (3) experience in practice; and (4) environmental and human needs. The answers on colour knowledge show that only 85% of participants chose the neutral option 3 or higher in the Likert scale, and that overall participants had an average level of knowledge...
Chapter 3: Method

(M=3.11, SD=6.61). In comparison, 88% agreed or strongly agreed that ‘the knowledge of colour is important to architectural design’ (M=4.2, SD=5.3). This suggests a significant gap between what architects are taught and what they feel they ought to know.

To investigate participants’ views on the role of colour in architecture, they were asked to rate the importance of colour as: (1) decoration; (2) part of the design concept; and (3) a functional element. The results show that 64% of participants thought that colour is of average or above importance as a functional element (M=3.8, SD=3.74), 48% thought that colour is of average or above importance as part of the design concept (M=3.96, SD=4.7) and 28% saw that colour is of average or above importance merely as a decorative component (M=3.2, SD=2). This suggests that architects most commonly view colour as an integral element of the design, rather than applied decoration. In line with common opinion about the comparative importance of colour use in interior and exterior spaces, the next question asked participants to rate the importance of colour use in three contexts. While 64% (M=4.6, SD=7) felt that colour is highly important in interior spaces, almost half believed that colour has a highly important role in building facades (M=4.3, SD=5.3), with 72% feeling colour is moderately or highly important in landscape (M=4, SD=4.3).

To investigate what factors inform architects’ colour choices, participants were asked to rate answers to three questions examining colour in the design process. The first question was: How important are the following factors when choosing colour for your designs? The eight proposed factors were identified through the literature review. Figure 3.2 shows that, except for ‘surrounding built environment’ (M=4.04, SD=4.1) and ‘climatic and geographic conditions’ (M=4.03, SD=4.81), which were identified as highly important design considerations by 42%
of participants, all other factors with the exception of one received a moderate level of importance (from 31% to 38%). Decoration was the least influential design consideration (M=2.92, SD=1.64). Interestingly, the ‘meaning of colour’ was only just ahead of decoration (M=3.1, SD=1.92), which might be said to reflect a lack of knowledge of this area.

Figure 3.2: Percentages of the impact of 8 factors on choosing colour for architectural design

Figure 3.3 shows responses to the four options for the question: How do you rate the importance to your colour use of the following socio-cultural factors? All four options reached a moderate level of importance, with the aesthetic taste of clients (M=3.84, SD=4.65) seen as the most influential socio-cultural factor informing colour choices. The other three themes – designer’s personal traits, cultural and religious value of colour, and symbolic meaning of colour respectively – received 38% (M=3.5, SD=4.2), 35% (M=3.5, SD=3.03) and 31% (M=3.6, SD=2.6).
The third question on what informs colour choices indicated that the physical and cultural context of the design, at 64% (M=2.54, SD=6.1), is the most important factor in colour decision-making, with a designer’s cultural background and colour preference equally as unimportant as design education (M=1.9, SD=1.15), well behind physical and cultural context.

The question: Who should make decisions for cities about the architectural use of colour? elucidated particularly interesting results. The comments reveal strong agreement (80%) on the belief that architects are responsible for colour decision-making. However, only 35% believed that the architect is the only professional who should make colour decisions (Figure 3.4). Thus, 48% believed in collaboration between architects and other professionals to make group decisions about the colour of the built environment, with the most dominant comments citing architects in collaboration with ‘urban designers and planners’ (32%) and with ‘community groups and clients’ (11%).
3.2.6 EDUCATIONAL BACKGROUND AND EXPECTATIONS FROM EDUCATION

53% of participants declared that their highest completed degree was a master’s, 24% a bachelor’s and 21% a PhD. Although the range of participants’ year of graduation varies, around half graduated between 2000 and 2009. Nearly half the participants stated that they did not have any colour-related course in their higher education. These comments indicate that none of the participants studied a course specifically on colour use or theory; rather, they had received basic information about colour theory as a part of another course with a different focus. Colour-related courses were mostly offered in the first year of a bachelor’s degree or as an elective. Participants’ responses to “state the colour-related course name” show that colour was studied in courses such as “form analysis”, “the elements and principles of design” and “ambiance”, and most commonly introduced via an “architectural studio”. Thus, knowledge of colour was most commonly learned through the process of designing or as an aspect of the design process.

The literature suggests that the educational system of the country of study can have a significant impact on the importance and place of colour knowledge in architectural curricula (Madden, Hewett & Roth 2000). Therefore, participants were
asked to declare the country of their undergraduate and postgraduate degrees. As one might expect from the multicultural population of Australia, responses show a wide range of countries including Egypt, India, Indonesia, Iran, Japan, Libya, Romania, Saudi Arabia, Spain, the UK and the USA. Due to the small sample, it is difficult to draw conclusions about the relationship between colour education and country of architectural study, but the results suggest that the prominence of colour in the architectural curriculum has a relationship with the cultural importance of colour in the country of study.

As an example, participants who studied in India, Japan and the UK saw colour as very important, claiming they had good colour knowledge from colour courses in their education. Moreover, participants studying in these countries were able to name a studied colour course and its content. In contrast, the participants who studied in other countries such as Australia and Iran predominantly rated the importance of colour with more variability. They were less certain about whether they had studied colour courses and most could not remember the name of the course. The last question on education sought level of agreement with the statement: ‘The higher education that I received in colour theory was thorough’. More than half of participants disagreed or strongly disagreed with the statement, while 32% answered neutrally, leaving only 16% who agreed or strongly agreed that they had received a thorough colour education (M=2.48, SD=3.1).

Five questions were dedicated to the role of higher education and practice experience. The results reveal that while nearly half of the participants agreed ‘higher education should play a role in informing knowledge about colour use in architecture’ (M=4.125, SD= 4.92), only 48% agreed or strongly agreed that ‘higher education had an impact on my understanding of use of colour’, 28% were neutral and 24% disagreed or strongly disagreed with this statement. It seems that the
educational culture of schools had only a minor influence on colour preferences (M=3.08 out of 5, SD=2.82), with only 12% feeling that the design aesthetic/philosophy/stance of their school highly influenced their use colour when designing. When answering: How do you rate the impact of practical experience on use of colour in your design process?, almost 52% felt their practical experience had a moderate impact on their colour use (M=3.76, SD=4.94), 20% highly, 20% somewhat and 8% not at all.

To investigate expectations from architectural education with regards to the teaching of colour knowledge, three open-ended questions were asked. The qualitative data gathered was analysed by coding the comments via grounded theory (Charmaz K 2014; Glaser & Strauss 2009). Codifying the most dominant responses to the question: What kind of colour information and training is it necessary to receive in architectural education? revealed four themes: ‘introduction to colour theory’, ‘colour use in architectural design’, ‘influence of colour on community’ and ‘colour, industrial and natural material’. The comments suggest that participants believed architects should have at least a basic knowledge of colour theory, its role in design and impact on the community, and how to use colour in architecture. The second question: In which courses/units do you think colour study should be taught? reveals a variety of suggestions. The most dominant course suggestion (Figure 3.5), with (43%), is ‘architectural design’ and the second highest is ‘architectural design theory’ with nearly 15%, while 10% of participants stated that the course should be offered in communication subjects or that its place of offer depends on the needs and context of the discipline.
Thus, we see that the findings of this study are very much in line with those of Janssens and Mikellides (1998), who conclude that while architecture undergraduates perceived and evaluated colour as one of the most important concerns in their professional careers, they received little teaching on the subject. Similarly, nearly 20 years later, while the pilot data sees a clear recognition among practising architects, academics and postgraduates of the central role of colour to practice, this contrasts sharply with a lack of taught colour knowledge. Other similarities and some differences can be seen between the two studies. Like the Janssens and Mikellides (1998) study, the pilot survey did not find evidence of any correlation between gender, age and recognition of the importance of colour. But unlike the Janssens study, the pilot suggested cultural differences. Although the Janssens and Mikellides (1998) study is a cross-cultural one, cross-cultural differences were not discussed by them, an omission that could be due to a lack of difference between Sweden and the UK.

3.2.7 GENERAL HYPOTHESES

Based on the literature review and findings from the pilot survey, the following general hypotheses were theorised for further investigation.
(H-1) A lack of education about colour theory affects architects’ propensity to use colour in their designs.

(H-2) The educational background of an architect affects their colour understanding, and their attitude to colour use when designing, but not their colour preference or actual colour use.

(H-3) Advances in digital technology have changed the use of colour in architectural design.

(H-4) The cultural background of the architect has an impact on their colour preference and use in design.

(H-5) The educational system and country of study (culture) have a significant impact on colour knowledge and consideration in design, or: The colour content of architectural curricula has a relationship with the cultural importance of colour in the country of study.

(H-6) Colour is generally viewed as a design element that is more important to interiors.

(H-7) Colour is not seen as an integral design influence but largely as a decorative element.

(H-8) The practical experience of architects has an impact on their colour preference and use in design.

(H-9) Colour decisions are made late in the design process.

(H-10) Architects believe that two stakeholders are primary responsible for choosing colour: clients and architects.

(H-11) Architects believe colour decisions should be made by a multidisciplinary team rather than being the primary responsibility of architects.

(H-12) The most significant impact on architects’ colour use is client preference.
(H-13): Both genders of architects have a similar positive response to colour importance, or: Both genders of architects have a similar attitude towards how colourful architectural designs should be.

(H-14): Age and the decade of education have little impact on an architect’s attitudes towards colour use in design.

Moreover, the result from the pilot survey raised more detailed questions:

- Does personal attitude have an impact on use of colour in design?
- Does the typology of a project have an impact on architects’ colour use?
- How much do environmental factors affect architects’ colour choices?

Considering the importance of this issue, it is worth referring back to the definition of colour use (Section 2.5). In this study, the notion of colour use in architectural design consists of two aspects: (1) the colours that architects choose for a design; and (2) how colourful the design is.

3.3 PILOT REVISION

To summarise, in the first phase of the study a pilot survey tested the viability of an initial questionnaire distributed among two small groups of: postgraduate higher-degree-by-research architectural students (HDRs), and academics and practising architects. The analysis of qualitative and quantitative data from the pilot, published elsewhere (Motamed, Tucker & Grose 2015), reveals an absence of sufficient and thorough education on colour, but general agreement on the importance of colour in architectural design. The findings also suggest that personal colour preferences and attitudes towards colour use may be traced to socio-cultural and religious influences and to social semiotics, and can influence architects’ colour choices. Thus, analysis of the pilot demonstrated the need for a more comprehensive questionnaire able to address the research hypotheses, in particular allowing for the exploration of cultural impacts on colour use.
Chapter 3: Method

The final survey was thus redesigned as an international survey to be circulated to two countries with significant cultural differences – Iran and Australia. Iran was chosen as the second country for a number of reasons: (1) it is highly culturally divergent from Australia, where the majority of the population has cultural origins in either Europe or East Asia; (2) like Australia, Iran spans a wide range of climatic zones (from cold and dry to hot and dry and hot and humid) and hence colour use dictated by light considerations and climate typology might be less varied than in comparing countries of very different climates; and (3) the Iranian heritage of the thesis candidate reduced recruitment difficulties.

Thus, three primary categories of change were applied in the design of the final instrument: (1) deleting or reducing requested items in some questions on areas identified by pilot participants as unimportant or partly irrelevant; (2) adding questions about factors newly identified in the pilot qualitative data, such as the impact of technological advances and cultural background, and finer interrogation of client influence; and (3) changing and adding new questions more readily able to reveal participants’ personal colour attitudes and preferences – through semantic differentials and response to visual colour prompts. The changes resulted in a redesigned survey structure with five different types of questions: multiple-choice, open-ended, semantic differential, visual interpretation of images and Likert scale (Table 3.12). The following few pages describe the redesigned instrument in detail.

Research from two studies informed additions to the final survey. Semantic differential questions, informed by Smith’s study (2003), were added that ask participants to describe the colour palette of their designs using 24 listed adjectives. The redesigned survey also contains two questions from Ural and Yilmazer’s study (2010). These consist of seven bipolar scales asking architects to describe their colour choice for the exterior and interior of two designs. Similar to the pilot survey,
the structure of the final survey and the questions for testing colour knowledge were informed by Janssens and Mikellides’ (1998) survey; but while that survey was composed of six blocks plus a comments section, the final thesis survey has eight blocks in three sections, as summarised in Table 3.12.

Table 3.12: Structure of final survey questionnaire

<table>
<thead>
<tr>
<th>Block</th>
<th>Specific content</th>
<th>Type of question</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Multi-choice</td>
</tr>
<tr>
<td>Section I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-1</td>
<td>Demographic</td>
<td>✓</td>
</tr>
<tr>
<td>B-2</td>
<td>Personal colour preference and attitude</td>
<td>✓</td>
</tr>
<tr>
<td>B-3</td>
<td>Colour knowledge</td>
<td>✓</td>
</tr>
<tr>
<td>B-4</td>
<td>Colour education</td>
<td>✓</td>
</tr>
<tr>
<td>B-5</td>
<td>Colour in practice</td>
<td>_</td>
</tr>
<tr>
<td>Section II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-6</td>
<td>Colour in context</td>
<td>_</td>
</tr>
<tr>
<td>B-7</td>
<td>What informs your design colour choices?</td>
<td>✓</td>
</tr>
<tr>
<td>B-8</td>
<td>General questions</td>
<td>_</td>
</tr>
</tbody>
</table>

While the focus of Sections I and II of the final instrument echoes the pilot, the content, type and number of questions are different. Section III departs most significantly from the pilot, focusing on the contextual factors affecting individual designs. Block B-1 is on demographics, B-2 on personal colour preferences and attitudes, B-3 on colour knowledge, B-4 on colour education, B-5 and B-6 on contextual influences on colour use and B-8 on the wider context of colour use.

3.4 FINAL SURVEY PROCEDURE

This section first outlines the implementation procedure of the final survey, including the process of ethics approval and the methods been used to invite participants to complete the survey. Next it describes the two groups of participants (Section 3.3.3), followed by a detailed description of the final survey (Section 3.3.4)
and refined hypotheses (Section 3.3.5). Section 3.4 discusses the process of variable refinement, followed in Section 3.5 by description of the quantitative and qualitative analysis methods. Finally, Section 3.6 provides a summary of the chapter.

3.4.1 ETHICS APPROVAL

For the final survey in Australia, a series of modifications were sent to HEAG as an amendment to the pilot survey previously approved. The list of modifications was as follows:

1. In order to be able to invite more participants, it was decided to use the public domains of Twitter and LinkedIn in addition to the previously approved email invitation method. Potential participants were to be identified via a public invitation to partake in the research posted on Twitter and LinkedIn.

   **Email:** Those who respond to the invitation via email were then to be forwarded a further email outlining the project intentions and seeking willingness to participate. The second email contained a web-link to the survey and a copy of the Plain Language Statement.

   **Twitter:** An invitation note was to be posted on Twitter within the 140-character limit (Figure 3.6):

   First tweet: “If you are an architect and would like to participate in a survey on what informs architects’ colour choices? Please email bmotamed@deakin.edu.au.”

   Second tweet: “A link to the survey on what informs architects’ colour choices? For HDR students: http://questionpro.com/t/AliXCSzS0Hz.”

   Third tweet: “A link to the survey on what informs architects’ colour choices? For Academics & Practitioners of architecture: http://questionpro.com/t/AliXCSzSisY.”
LinkedIn: Participants were to be identified via a public invitation posted on LinkedIn. As LinkedIn does not have a word limit, the invitation was in one post (Figure3.7):

“If you are an architect, an academic or a student of architecture and would like to participate in a survey on what informs architects’ colour choices? Please find the links below. A link to the survey for HDR students: http://questionpro.com/t/AlizXCSScHz. If you have any questions or require further information, please do not hesitate to contact Bahareh Motamed at bmotamed@deakin.edu.au.”
2. It was found in the pilot that the influence of cultural and educational differences may play an important role in colour use and knowledge. Thus, the final survey was expanded to be distributed in Iran and Australia.

Ethics approval for the final survey for Australia was obtained from Deakin University Human Research Ethics Advisory Group (HEAG) as an amendment to the original approved survey in Australia on 20 July 2015 (Project ID STEC-44-2014-MOTAMED). The approval of the ethics application for conducting the final survey in Iran, which was submitted as an individual case, was granted by HEAG as a low-risk application on 9 September 2015 (Project ID STEC-30-2015-
MOTAMED). As the Iranian participants might not have been able to communicate easily in English, the survey was translated into Persian.

3.4.2 PARTICIPANT INVITATION

**Invitation method for academics and students:** Universities teaching architecture were identified via their websites in both Iran and Australia. Permission to distribute the survey web-links was sought from heads of schools at these universities. The email included survey description, aims and conditions, Plain Language Statements (PLS) and invitation letters/emails for both students and academics. In the student invitation, it was made clear that participation in the research was completely voluntary and not linked to assessment or learning requirements within courses of study. Based on the decisions of the heads of schools, an invitation email was sent to potential participants via one of two methods: (1) head of school forwarded invitation email and PLS to students and academics; (2) invitations were sent via email directly from researcher to a group email, obtained from heads of schools, for students and/or academics. For Iranian participants, a link to the Persian translation of the surveys was provided.

**Invitation method for practitioners:** Architectural and urban design firms were selected for invitation, from numerous firms (largely online) that were considered to have the resources to allow individual architects the time to complete the survey – based on practice size, reputation and/or prize-winning history. To obtain permission from a point of contact at each practice (e.g. a senior partner or practice manager), the researcher contacted each practice via phone or email to invite the practice to participate. A follow-up invitation email, containing a web-link to the questionnaire, was sent to those practices that granted permission (Table 3.13).
Table 3.13: List of contact details of professional architects and firms

<table>
<thead>
<tr>
<th>Country</th>
<th>Professional resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iran</td>
<td>• Member list of Syndicate of Consulting Architects &amp; Planners (<a href="http://www.scapiran.com">http://www.scapiran.com</a>)</td>
</tr>
<tr>
<td></td>
<td>• List of urban planner and urban designer members of Iranian Society of Consulting Engineers (<a href="http://www.irsce.org/en">http://www.irsce.org/en</a>)</td>
</tr>
<tr>
<td></td>
<td>• List of architect members of Iranian Society of Consulting Engineers (<a href="http://www.irsce.org/en">http://www.irsce.org/en</a>)</td>
</tr>
<tr>
<td></td>
<td>• List of consultant companies from Tehran Construction Engineering Organization (<a href="https://www.tceo.ir">https://www.tceo.ir</a>)</td>
</tr>
<tr>
<td></td>
<td>• List of architects from Iran’s Architecture Pride Worthies’ Foundation (<a href="http://www.ammi.ir/en">http://www.ammi.ir/en</a>)</td>
</tr>
<tr>
<td></td>
<td>• List of architects from news: young architects who won international prizes recently</td>
</tr>
<tr>
<td></td>
<td>• Telephone book</td>
</tr>
<tr>
<td>Australia</td>
<td>• The project supervisor, Associate Professor Richard Tucker, sought permission from a point of contact at each practice (a senior partner) for the researcher to invite the practice to take part</td>
</tr>
<tr>
<td></td>
<td>• Australian Institute of Architects (<a href="http://www.architecture.com.au/">http://www.architecture.com.au/</a>)</td>
</tr>
<tr>
<td></td>
<td>• Designer8 website (<a href="http://www.dexigner.com/">http://www.dexigner.com/</a>)</td>
</tr>
<tr>
<td></td>
<td>• <a href="http://architectureau.com/">http://architectureau.com/</a></td>
</tr>
</tbody>
</table>

Furthermore, social media was identified as another source for finding participants. Thus, Twitter and LinkedIn were selected as appropriate platforms for the following reasons:

- **Twitter**: offers convenience and speed for circulating invitations. By ‘following’ architects, practitioners and postgraduate groups of different architectural universities, Twitter provided the opportunity to circulate the invitation among a large pool of potential participants.

- **LinkedIn**: is one of the world’s largest professional networks, with more than 400 million members in 200 countries and territories around the globe (LinkedIn web page), and thus provided access globally to architects and practitioners and even postgraduate architectural students.

3.4.3 PARTICIPANTS

Similar to the pilot survey, two groups of: (1) postgraduate students; and (2) academic and practising architects were selected as potential participants. The first

---

8 Designer website is an online portal (founded in 2001) for designers, architects, illustrators, engineers, artists and creatives of all kinds (http://www.dexigner.com/).
group of participants were master’s and PhD students in schools of architecture, urban design and planning in Iran and Australia. Students in both countries were invited to complete the online survey instrument “Students’ Experiences in Relation to the Use of Colour in the Built Environment”. The second group of participants were drawn from two sources: academics from architectural schools in both Iranian and Australian universities; and practising architects in both Iran and Australia. They were invited to complete the online survey instrument “Academic and Professional Experiences in Relation to the Use of Colour in the Built Environment”.

From 1175 participants who started the surveys in Question- Pro, 274 completed questionnaires were received; 44.16% of responses were from Iran and the rest from Australia. 62.77% of participants were professionals and academics and 37.23% were postgraduate students. The overall gender distribution was fairly evenly split with 49.27% men, 48.91% women and 1.82% preferring not to say. Although the gender distribution among the cohorts of architects and academics was almost equal, there was a marked discrepancy between genders for the students, with more women (61%) than men (39%). The ages of respondents varied, with 87% of participants in the age range of 22–50, meaning most had experience in the study and/or practice of architecture.

3.4.4 SURVEY DESCRIPTION

As described in Section 3.2 (Table 3.12), the final survey has eight blocks in three sections. The academic/professional survey consists of 85 items and the postgraduate survey 79 items. Both were circulated in Iran and Australia. The average time for completing the survey was reported as 25–30 minutes.

The first section of the final survey, which contains B-1, establishes participant demographics via 11 questions, including those on cultural and
educational background. This section includes multiple types of questions. The first 5 questions are on personal demographics, including age, gender, highest completed degree and occupation. The second part includes questions on year of graduation, and country of: childhood, undergraduate degree(s), postgraduate degree and architectural practice. Finally, two questions investigate cultural influences: the level of participants’ agreement (on a 5-point Likert scale) with the importance of colour in their culture; and an open-ended question asking about any colour biases in their home country (Figure 3.8).

The second section of the survey, designed to examine the level of participants’ colour knowledge and experience, has four blocks: (B-2) personal colour preference and attitude; (B-3) colour knowledge; (B-4) colour education; and (B-5) practical experience. In B-2, participants were asked to rate their tendency towards colour use for interiors/exterior (from 1 = Colourless to 7 = Colourful) (Figure 3.9). To determine attitudes towards colour use, participants were asked to rate their general colourfulness preference (from 1 = Colourless to 7 = Colourful) for: (1) architecture; (2) interiors; and (3) exteriors. Participants also rated on a 5-point Likert scale how important they perceived colour use to be to architecture (from 1 = Not at all to 5 = Very important) (Figure 3.10).
2.1 Please rate your colour preference on a continuum: from 1 (colourless) to 7 (colourful)
-- Select -- 

2.5 What is your tendency towards colour use for interiors of buildings? Please rate your colour preference on a continuum: from 1 (colourless) to 7 (colourful)
-- Select -- 

2.6 What is your tendency towards colour use for exteriors of buildings? Please rate your colour preference on a continuum: from 1 (colourless) to 7 (colourful)
-- Select -- 

Figure 3.9: Preview of three questions about architects’ tendency in use of colour for interior/exterior of buildings
(source: final survey)

This block also contains a series of yes/no and open-ended questions about participants’ colour preferences and choices (Table 3.14).

Table 3.14: Table 3.11: Examples of open-ended questions in Section II

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.2 What is your favourite colour? Why?</td>
<td></td>
</tr>
<tr>
<td>2.3 What is your least favourite colour? Why?</td>
<td></td>
</tr>
<tr>
<td>2.4 When designing do you imagine (or visualise) the design in colour as it develops?</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
</tbody>
</table>

To measure colour knowledge, the survey differentiates between what participants thought they knew and what they actually knew about colour, thus delineating a knowledge gap. Therefore the first two questions of B-3 ask participants to self-rate their overall colour knowledge via a 6-point Likert scale (from 1 = None to 6 = Expert) and then rate the importance of colour in architecture (from 1 = Not at all to 5 = Very important). The next 20 questions were designed to measure the level of participants’ colour knowledge via two types of questions: the first 10 items contain more general questions testing colour knowledge, asking participants to self-rate their level of knowledge and familiarity with colour-related words from 1 (None) to 6 (Expert) (Figure 3.11); while the next 10 questions (informed by Janssens and Mikellides (1998) study), test what might be considered more specialised knowledge.
As the literature suggests (O’Connor 2011; Smith 2008), use of different types of questions such as single choice, multiple choice and specifically visual questions can facilitate colour imagination and increase participant engagement with questions on colour. Thus, a number of multiple-choice questions are also offered in a visual format in this block (Table 3.15).
### Table 3.15: Next 10 detailed questions about colour knowledge (source: final survey)

1.2.1 Do you know what ‘CMYK’ stands for (select all that apply)?

1.2.2 The after-image of the colour Red (in white background) is (select all that apply)?

1.2.3 The primary colours of light (additive colours) are (select all that apply)

1.2.4 Which of the following five colours has the highest visual strength?

1.2.5 Select the colours that correspond to the subtractive colour primaries (select all that apply)

1.2.6 Select the colour that corresponds to digital representation: R=255, G=0, B=0.

1.2.7 Select the colour that corresponds to the digital representation: R=255, G=255, B=0.

1.2.8 A “Magenta” surface is one which

1.2.9 What is the Pantone series of colours used for (select all that apply)?

1.2.10 What distinguishes the Natural Colour System from other systems (select all that apply)?

The fourth block (B-4) investigates the level and context of colour education provided at university. The first two questions ask whether participants received any colour training in their university or college, and are followed by an open-ended question for elucidating more detailed information. To investigate the influence of colour education on their design practice, participants are asked to rate on a 5-point Likert scale their level of agreement with three statements (Figure 3.12).
Please rate your answers to the following questions from:

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>Minimally</td>
<td>Somewhat</td>
<td>Moderately</td>
<td>Highly</td>
</tr>
</tbody>
</table>

4.2 Do you feel that higher education should play a role in informing knowledge about colour use in architecture? [options]

4.3 How much do you agree with this statement "the higher education that I received in colour theory was thorough"? [options]

4.4 How much do you think that your higher education had an impact on your use of colour when designing? [options]

4.5 I was often given direction in my design education about the use of colour in my own designs. [options]

Figure 3.12: Preview of three questions about colour education (source: final survey)

The last block of Section II (B-5) contains 10 questions on the relationship between colour use and practical experience. Participants are asked here to rate their answers to two types of 5-point Likert-scale questions: (from 1 = Not at all to 5 = Very important and from 1 = Strongly agree to 5 = Strongly disagree). The first two series of Likert-scale questions seek to investigate the relative importance of colour to different design stages and of the functional uses of colour in the design process (Figure 3.13).
Chapter 3: Method

Please rate your answers to the following questions:

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>Not at all</td>
<td>Minimally important</td>
<td>Somewhat</td>
<td>Moderately important</td>
<td>Very Important</td>
</tr>
</tbody>
</table>

5.2 For each of the following four phases of design, how important is the use of colour to your design thinking?

- During concept design/idea generation
- During schematic design
- During design development (for planning and other regulatory requirements)
- During detail design - when materials are selected
- During the construction phase

5.3 Rate the importance of the following functions of colour to your design process:

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>Not at all</td>
<td>Minimally important</td>
<td>Somewhat</td>
<td>Moderately important</td>
<td>Very Important</td>
</tr>
</tbody>
</table>

- As an element used to encourage a psychological/emotional response;
- As an element used to contrast or blend a design to its physical context;
- As an integral generator of the design concept;
- As applied decoration;

Figure 3.13: Preview of B-5 of Section II (source: final survey)

The second type of Likert-scale question seeks level of agreement with different statements on what influences colour palette ranges and on the impact of new technologies (Figure 3.14). These are followed by open-ended question for more detailed information related to this block.

Figure 3.14: Preview of B-5 questions in relation to influential factors on colour palette range and technological development (source: final survey)
Chapter 3: Method

The third section of the survey contains three blocks. The first block (B-6), which contains two types of 5-point Likert-scale questions, covers the relative influence of contextual factors on colour decision-making for all design projects. The purpose of the first question is to rate the importance of colour in three design contexts: building interiors, exteriors and landscaping. The second Likert-scale question asks participants to rate the impact of four influences on their colour decisions for all design projects: clients; architects’ own cultural background; planning and other legislative restrictions; and architects’ own personal colour preferences.

The B-7 questions determine the relative importance of a number of contextual influences on colour choices for two prominent recent design projects (a built project or a hypothetical paper-based design). At the first step, participants are asked to nominate two designs and explain their attitude and preference towards colour use in those two different contexts. The use of two designs provides case studies of the colour decision-making process in two different contexts, thus allowing an examination of the relationship between context and colour use, and consequently which factors influencing colour use are consistent between projects and which ones vary. Thus, B-7 includes the importance rating of 19 generally accepted functions of colour in architectural design (Figure 3.15).

At the second step, a serious of questions investigate the process of colour decision-making and the influence of other people (built environment professionals, clients etc.), contextual factors (cultural and physical), and designer preferences and attitudes towards colour. To address the complexity of this issue, different types of questions are used. Thus, for each nominated project, first participants are asked to rate the colourfulness of their project from (1) colourless to (7) colourful. Next, the importance of 19 generally accepted functions of colour in architectural design was rated (Figure 3.16).
As the pilot survey identified clients as one of the most important influences on architects’ colour decision-making, the survey of academic and practising architects contains an extra 4 questions exploring the relationship for the two designs between clients’ colour preferences and requirements, and designers’ colour choices. As the manner in which architects perceive and express the reasons for their use of colour is highly subjective, semantic differential questions are used here to reduce unmeasurable data. Two types of semantic differential questions are used. The first, informed by Smith’s (2003) study, asks participants to describe the colour palette of their design using 24 adjectives. The following two questions are of a second type, consisting of 7 bipolar scales (Table 3.16) informed by Ural and Yilmazer’s (2010) study and first identified by Osgood et al. (1957). These two questions ask architects to describe their colour choice for the exterior and then the interior of the two designs. For example, for the first pair, 1 describes your choice of colour palette as ‘harmonious’, 7 describes it as ‘discordant’, while 4 indicates midway between the two extremes. The intention here is to determine semiotic differentials between interior and exterior colour use.

Finally, the last block of this section (B-8) contains questions on the colourfulness of participants’ portfolios of designs, from 1 (colourless) to 7 (colourful), the relative influence of different stakeholders in colour decision-making, current trends in colour use and innovation, and additional space for comments or suggestion about the research.
Table 3.16: Example of 7 bipolar scales questions which seek participants’ attitude and feeling toward their colour choices for their designs

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimally</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>important</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Somewhat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderately</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>important</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very Important</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

• Typology of the design
• The urban density of the site
• Visible natural features
• Colours of immediately neighbouring buildings
• Colours of prominent buildings that are visible from the site
• Historical use of colour at the site
• Building orientation
• Building height
• Building form
• Climatic conditions
• Solar light intensity and angle at the site
• Urban design / planning restrictions
• Cultural context – e.g. customs and religion
• The colour of the building at night
• The psychological impact of colour
• The relative importance of standing out or blending in
• Safety coding
• Perception of space
• Way finding

Figure 3.15: How do you rate the importance of the following contextual influences on your colour selection for this design?

Table 3.16: Example of 7 bipolar scales questions which seek participants’ attitude and feeling toward their colour choices for their designs

7.18 Describe your colour choice for the exterior of the building on the following 7 bipolar scales. For example, for the first pair, 1 describes your choice of colour palette as “harmonious”, 7 describes it as “discordant”, while a 4 indicates midway between the two extremes.

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harmonious/ discordant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pleasant/ unpleasant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comfortable/ uncomfortable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spacious/ confined</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Static/ dynamic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exciting/ calming</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introverted/ extroverted</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
As the possible need to explore some of the questions in greater detail was anticipated, at the end of the survey participants are asked to contact the researcher as previously described in Section 3.3.

3.4.5 REFINED HYPOTHESES

During the design of the final survey, a process informed by the findings from the pilot, the 14 initial research hypotheses were simplified to 7. While the scope of the final survey provides data to elucidate the relative influence of the many and varied influences on colour choice during the architectural design process, these seven hypotheses were focused on testing the theory that education, culture and the contextual variables of a design are the three most important factors that inform architects’ colour use. As such, it was hypothesised:

(H.1): The educational background of an architect affects their colour understanding and their attitude to colour use when designing, but not their personal colour preferences or actual colour use.

(H.2): The cultural background of an architect affects their attitude to colour use when designing, their colour preference and colour use.

(H.3): Architects’ colour use will vary between designs.

(H.4): The higher the level of an architect’s colour knowledge, the more colourful will be their designs.

(H.5.A): Of the multiple practice influences on the use of colour in built environment design (architects’ preferences, clients’ preferences, local planning authorities (LPA), urban designers, colour consultants and design context), architects will perceive that only the clients’ preferences and the design context are significant.
(H.5.B): Of the multiple influences on an architect’s actual colour use (architects’ preferences, clients’ preferences, LPA, urban designers, colour consultants and design context), only the architects’ preferences, clients’ preferences and the design context will be significant.

(H.6): Of the general factors that inform an architect’s colour use (colour knowledge, culture, attitudes and preferences), architects perceive that knowledge has the greatest impact; and

(H.7): Architects will see that of the three general contexts for colour use (exteriors, interiors and landscape), colour is of most importance to interiors.

3.5 VARIABLE REFINEMENT

Based on the variables affecting colour choice identified in the literature review (Sections 2.1 and 2.4) and the pilot survey findings, and ultimately the seven refined hypotheses, the final survey is divided into six main variable categories: (1) demographics including age and gender; (2) colour education; (3) culture; (4) colour knowledge; (5) colour orientation (colour attitude and preference); and (6) practice (which contain two sub-themes: people and context). Table 3.17 shows the survey questions devoted to each of these variables.

Table 3.17: All questions and variables selected for analysis to facilitate research hypotheses and objectives

<table>
<thead>
<tr>
<th>Variables category</th>
<th>Question</th>
<th>Variable Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Demographic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>1.1 Gender</td>
<td>Gender</td>
</tr>
<tr>
<td>Age</td>
<td>1.2 Age</td>
<td>Age</td>
</tr>
<tr>
<td>(2) Colour Education</td>
<td>4.1 In your university or college education and training was the study of colour part of your design course or curriculum? Please explain.</td>
<td>Colour training</td>
</tr>
<tr>
<td></td>
<td>4.2 How much do you agree with this statement “The higher education that I received in colour theory was thorough”?</td>
<td>Thoroughness of colour theory education</td>
</tr>
<tr>
<td></td>
<td>4.3 How much do you think that higher education had an impact on your understanding of the use of colour?</td>
<td>Perceived impact of education on colour knowledge</td>
</tr>
</tbody>
</table>
### Chapter 3: Method

<table>
<thead>
<tr>
<th><strong>4.5</strong> I was often given direction in my design education about the use of colour in my own designs.</th>
<th>Thoroughness of colour practice (in design) education</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.6</strong> In which city do you currently practise or study?</td>
<td>Country of practice</td>
</tr>
<tr>
<td><strong>1.7</strong> In which country did you spend the majority of your childhood?</td>
<td>Country of childhood</td>
</tr>
<tr>
<td><strong>1.8</strong> In which country did you receive each of the following degrees? (1,2,3)</td>
<td>1st degree / 5.2 2nd degree/ 5.3 P/G degree</td>
</tr>
<tr>
<td><strong>1.9</strong> Colour has an important role in the cultural traditions of my home country.</td>
<td>Cultural potency of colour</td>
</tr>
<tr>
<td><strong>1.10</strong> Tell us about colour biases in your home town and how it reflected (at all) in built environment? If yes tell us which colour.</td>
<td>Cultural colour bias</td>
</tr>
<tr>
<td><strong>6.2</strong> Rate the impact of each of the following factors on your use of colour in your design work in general? (cultural background)</td>
<td>Perceived impact of cultural backg’nd on colour use</td>
</tr>
<tr>
<td><strong>3.2</strong> Self-rate your OVERALL knowledge of the use of colour in architecture.</td>
<td>Self-rated overall colour knowledge</td>
</tr>
<tr>
<td><strong>3.3</strong> Please rate your knowledge and familiarity with the words below:</td>
<td>Self-rated specific colour knowledge</td>
</tr>
<tr>
<td><strong>3.4-13</strong> Colour knowledge test score</td>
<td>Tested Colour Knowledge</td>
</tr>
<tr>
<td><strong>6.2</strong> Rate the impact of each of the following factors on your use of colour in your design work in general? (colour knowledge)</td>
<td>Perceived impact of colour knowledge on colour use</td>
</tr>
<tr>
<td><strong>2.1</strong> Please rate your colour preference on a continuum from colourless to very highly colourful.</td>
<td>General colourfulness preference</td>
</tr>
<tr>
<td><strong>2.2</strong> What is your favourite colour?</td>
<td>Favourite colour</td>
</tr>
<tr>
<td><strong>2.3</strong> What is your least favourite colour?</td>
<td>Least favourite colour</td>
</tr>
<tr>
<td><strong>2.4.2</strong> Do any colours or hues tend to dominate? (Yes/no)</td>
<td>Dominant colour</td>
</tr>
<tr>
<td><strong>2.5</strong> What is your tendency towards colour use for interiors?</td>
<td>Architectural Colourfulness Preference – interiors</td>
</tr>
<tr>
<td><strong>2.6</strong> What is your tendency towards colour use for exteriors?</td>
<td>Architectural Colourfulness Preference – exteriors</td>
</tr>
<tr>
<td><strong>3.1</strong> How important do you think the use of colour is in architecture?</td>
<td>Perceived importance of colour to architecture</td>
</tr>
<tr>
<td><strong>5.3</strong> Rate the importance of following functions:</td>
<td>Colour function</td>
</tr>
<tr>
<td><strong>5.6</strong> For each different design project, designers should try to use a strict colour palette that is informed by the specific urban context.</td>
<td>Context sensitive palette</td>
</tr>
<tr>
<td><strong>5.9</strong> For all of my design, I normally stick to a similar colour palette.</td>
<td>Strict colour palette</td>
</tr>
<tr>
<td><strong>6.1</strong> How do you rate the importance of colour in: (interiors, exteriors, landscape)?</td>
<td>Importance of colour to built environment</td>
</tr>
<tr>
<td><strong>6.2</strong> Rate the impact of each of the following factors on your use of colour in your design work in general? (colour preference &amp; attitude)</td>
<td>Perceived impact of attitudes on colour use</td>
</tr>
<tr>
<td><strong>6.2.5</strong> Client</td>
<td>Perceived impact of client</td>
</tr>
<tr>
<td><strong>8.2.1</strong> Urban designer</td>
<td>Perceived influence of urban designers</td>
</tr>
<tr>
<td><strong>8.2.2</strong> Architect</td>
<td>Perceived influence of architect</td>
</tr>
<tr>
<td><strong>8.2.3</strong> Client</td>
<td>Perceived influence of client</td>
</tr>
<tr>
<td><strong>8.2.4</strong> Local planning authority</td>
<td>Perceived influence of LPA</td>
</tr>
<tr>
<td><strong>8.2.5</strong> Specialist colour consultant</td>
<td>Perceived influence of colour consultant</td>
</tr>
<tr>
<td><strong>7.5</strong> How much did these people have an impact on your colour choice for your design (1+2)?</td>
<td>Specific impact of urban designer (TV)</td>
</tr>
</tbody>
</table>
### Chapter 3: Method

#### 7.5.2 Client Specific impact of client (TV)

#### 7.5.3 Architect Specific impact of architect (TV)

#### 7.5.4 Local planning authority Specific impact of LPA (TV)

#### 7.2 Tell us about other people who influence the use of colour in the built environment?

<table>
<thead>
<tr>
<th>Context</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.2 Rate the impact of each of the following factors on your use of colour in your design work in general?</td>
</tr>
<tr>
<td>6.2.4 Designs cultural and physical context Perceived impact of context</td>
</tr>
<tr>
<td>7.3.14 How colourful were Designs 1 &amp; 2? (from colourless to very highly colourful)? Specific colourfulness of Designs 1 &amp; 2</td>
</tr>
<tr>
<td>7.4 Rate the importance of the following contextual influences in your colour selection for this design (projects 1 &amp; 2)? (19 influences) Specific impacts of 19 context factors on Designs 1 &amp; 2</td>
</tr>
<tr>
<td>7.12/23 What informs your choice of colour for Design 1, Design 2? Reasons of colour choice for Designs 1 &amp; 2</td>
</tr>
<tr>
<td>8.1 How colourful would you say your portfolio of designs is? Colourfulness of design portfolio</td>
</tr>
<tr>
<td>8.4 Is there anything else you want to add?</td>
</tr>
</tbody>
</table>

### 3.6 SELECTION OF ANALYSIS METHODS

The final survey contains both quantitative and qualitative data to elucidate the research aims and hypotheses. Thus, mixed analysis methods have been used that employ qualitative and quantitative data collection and analysis techniques both in parallel and sequentially.

#### 3.6.1 QUANTITATIVE ANALYSIS

A series of statistical analyses was employed for analysis of the quantitative data, to overcome the multidimensional relationship between architects’ colour use, demographic features, culture, educational background and their colour knowledge and orientation. According to Pallant (2016), different analysis tests using SPSS can be divided into two categories. The first is the family of statistical tests that explore relationships between continuous variables, such as correlation, multiple regression, and factor analysis. Here, continuous variables are those providing a score or rating which can therefore be used as a value for measurement (Field 2013). For categorical variables (those made up of categories or groups such as gender, occupation, country of childhood), the chi-square test for relatedness or independence can be used to explore relationships.
Another set of statistical tests that explore differences in continuous variables between groups are analyses such as t-tests, ANOVA and MANOVA. Considering the nature of each of the five categories of variables (continuous/non-parametric (categorical and nominal) variables) and the relationships between them that the seven hypotheses require exploring, five types of statistical tests are used in this study. These can be divided into two categories of technique (Pallant 2016): (1) parametric techniques, which are ideal for variables that meet the normality distribution assumption; and (2) non-parametric techniques, which are ideal for testing nominal (categorical), ordinal (ranked) scales and those types of data not meeting the normality assumption. In this study three parametric techniques are used: (1) multiple regression; (2) Pearson correlation; (3) t-test including independent, one and paired sample t-tests; and two non-parametric techniques: (4) factor analysis; and (5) chi-square and crosstab test. A more detailed description of the application of each of these five types of analyses follows.

1. Multiple regression is commonly used to explore the predictive relationship between one continuous dependent variable and a number of independent variables (Pallant 2016). It also considers the relationship between all the predictive variables as a whole (the model) and the relative contribution of each predictive variable to the model. Multiple regression was used to evaluate the power of education, colour orientation and culture in predicting architects’ colour use. In order to meet the assumptions of multiple regression analysis, preliminary analysis was conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity. As it was found that two variables perceived importance of colour to architecture and specific colourfulness of designs violated the normality assumption, based on the
recommendations of the SPSS *Survival Manual* (Pallant 2016), the Log10 technique has been used to reach normality.

2. Pearson’s correlation coefficient is the most common measure of correlation and allows researchers to measure the statistical relationship, or association, between two continuous variables (Solution 2016). It not only describes the strength of the relationship between variables but also shows the direction of their linear relationship by giving a value between +1 and −1 inclusive (1 = total positive linear correlation, 0 = no linear correlation and −1 = total negative linear correlation). Pearson’s correlation has been used to evaluate the relationship of cultural background and colour knowledge to the colourfulness of the participants’ design portfolios.

3. Factor analysis is a data reduction technique that is not designed to test hypotheses. This technique condenses a large set of variables via summarising them into smaller sets of factors or groups based on the intercorrelations between variables. Factor analysis has been used in this study to reduce the 19 contextual variables influencing colour use (in design 1 and design 2) into smaller sets of groups. Factor analysis of these 19 variables for two case studies – designs 1 and 2 – has also provided an opportunity to investigate similarities or differences in grouping patterns between the two designs. It has therefore been used to determine how colour use varies between designs.

4. Chi-square and crosstab, which is also called the one-sample chi-square test, can be used to explore the relationship between non-parametric variables (categorical variables). This test allows a comparison of the proportion of cases from a sample with hypothesised values or those obtained previously from a comparison population (Pallant 2016). Chi-square and crosstab have been used
to explore the relationships between participants’ colour preferences (favourite and least favourite colours), gender and cultural background.

5. The t-test compares the mean scores of two populations by looking at t-distribution and degrees of freedom to determine the probability of difference between populations. There are three main types of t-test (Pallant 2016): (1) the paired sample t-test or repeat measure, which is usually used for comparing the changes in scores of the same group of participants on two different occasions; (2) the independent sample t-test, which is usually used to compare the scores of two independent groups of participants in one occasion; and (3) the one-sample t-test, which examines the mean difference between the sample and the known value of the population mean (Solution 2016). A paired-sample t-test has been used to compare the influence of the 19 design context factors between design 1 and design 2, and to compare the importance of colour use in interiors and exteriors. An independent sample t-test has been used to determine gender differences in participants’ colour preferences and attitudes towards colour. It has also been used to determine gender differences and cultural origin (country of childhood) differences (between Australia and Iran) of colour use in the interiors and exteriors of designs 1 and 2. A one-sample t-test has been used to examine differences between: the influence of people or professionals (such as architects, clients, LPA, urban designer, colour consultant); the influence of other factors such as culture, knowledge, colour orientation and design context; colour use in interiors, exteriors and landscape design; and the colourfulness of design 1, design 2 and portfolios of designs.

3.6.2 QUALITATIVE ANALYSIS

As is stated in Section 3.2 (refining the instrument), in addition to quantitative questions the final survey contains qualitative questions exploring the reasons behind
architects’ colour choices. It contains two types of qualitative questions: open-ended questions and semantic differential questions (i.e. list of adjectives). The analysis of open-ended questions is based on the six-step grounded theory approach developed by Creswell (2009): (1) data preparation; (2) obtaining general sense; (3) developing qualitative narrative via detailed analysis with coding process; (4) generating description (sorting data); (5) representing themes; and (6) interpretation and making meaning out of data.

Thus in this study, firstly the participants’ responses to open-ended questions have been coded using NVivo software. Secondly, the transcripts have been analysed to identify themes or patterns. Finally, emerging patterns and concepts from the data have been explored to gain a deeper understanding of the factors that influence architects’ colour choices. In the semantic differential questions, informed by Smith’s (2003) study, participants are asked to describe the colour palette of their designs using 24 listed adjectives. For analysis of this type of data, NVivo software has been used to investigate frequencies and patterns in participants’ adjective choices. The same method has also been used to explore any relationships between gender and the selected adjectives.

3.7 SUMMARY

This chapter has provided a comprehensive description of the methods and techniques implemented to address the aims of this study during its different stages. The methodological framework introduced in this chapter provides a link connecting the research gaps, methods and variables described in the literature review (Chapter Two) to the analyses described in Chapters Four and Five. Drawing on the theoretical framework developed in the literature review, this chapter has discussed a wide range of methods that can be used for data gathering and analysis in both qualitative and quantitative approaches. In light of the wide range of data required to test the
hypotheses (from a wide spread of participants in two different countries), an online survey was chosen as the data collection method.

The chapter started with a description of the pilot survey, the procedure of its development, receipt of ethical permission, and selection of participants. Based on the findings of the pilot survey data analysis, the hypotheses of the research were refined to inform the development of the final version of the survey, which was circulated in both Australia and Iran. The chapter then introduced the different methods used to analyse the two types of gathered data (qualitative and quantitative). Different statistical methods were reviewed for quantitative data analysis and those methods chosen – as informed by the research hypotheses and nature of the examined variables – were described in detail. Finally, the chapter described the six steps of grounded theory and use of NVivo software for analysing the semantic differential (list of adjectives) and other types of qualitative data.
CHAPTER 4:
ANALYSIS AND RESULTS
CHAPTER 4 – ANALYSIS AND RESULTS

4.1 INTRODUCTION

This chapter details the statistical analyses conducted to explore which factors influence architects’ colour choices and use in their designs. The chapter examines the impact of six main factors on architects’ colour choice and use, but focuses on a comparison of the roles that education and culture play in informing colour use in Iran and Australia.

Following on from the variables identified and refined in Section 3.4 (Table 3.17), the chapter reports on results of the analysis of five main categories of influence on colour use: (1) demographic features, including age and gender; (2) colour education; (3) colour knowledge; (4) culture; (5) colour orientation (colour attitude and preference); and (6) practice, which contain two themes: people and context. Due to overlaps between the first category (demographic influences) and the other five categories, the analysis of questions related to demographic features is presented along with the analyses of other related categories. Accordingly, as can be seen in Figure 4.1, the chapter presents five categories of influence: colour education, colour knowledge, culture, colour orientation and practice. Each of these five sections starts with a restatement of the related hypotheses or research questions, followed by description of the different analysis techniques used to test those hypotheses.
Chapter 4: Analysis and Results

Figure 4.1: Independent and dependent variables used for analysis
4.2 EDUCATION

It is hypothesised (H-1) that the educational background of an architect predicts their colour understanding and their attitude to colour use when designing, but not their colourfulness preference nor actual colour use (colour (hue) and colourfulness of designs). To test this hypothesis, seven individual multiple regression analyses have been conducted to investigate the predictive power of: (1) thoroughness of colour theory education; and (2) thoroughness of colour practice education, in predicting seven dependent variables in four categories (Figure 4.2): (1) colour knowledge (including perceived impact of education on colour knowledge); (2) colour attitude (containing architectural colourfulness preference and perceived importance of colour to architects); (3) colourfulness preference (including general colourfulness preference; and (4) colour use (including colourfulness of design portfolio and specific colourfulness of two designs).

Figure 4.2: The analysed variables in relation to education
It has been found that the two-variable model of thoroughness of colour education (consisting of colour theory and colour practice education) significantly predicts the perceived importance of colour to architecture of architects, accounting for 3.2% of the variance, $F(2, 161) = 3.72, p<0.001$; while neither predictor has significant part effects in the full model. It has been found that the two-variable model significantly predicts perceived impact of education on colour knowledge, accounting for 29.9% of the variance, $F(2, 159) = 33.835, p<0.001$, with theory education accounting for the greatest variance. Of the two variables (colour theory education and colour practice education), only colour theory education significantly predicts colour knowledge in the model. Moreover, it has been found that the two-variable model does not significantly predict architectural colourfulness preference, general colourfulness preference, colourfulness of design portfolio or specific colourfulness of designs.

Informed by the overwhelming agreement between participants surveyed in the pilot on the importance of colour knowledge for architects, participants in the final survey were asked to respond to the yes/no question: In your university or college education and training, was the study of colour part of your design course or curriculum? According to the results, 68.4% of participants claimed that they did not receive any colour training. The participants claiming they had had colour training (31.6%) were asked for further explanation of the content of their colour studies (Table 4.1). Codifying the most dominant responses reveals that a basic level of colour training was offered most often in “communication” and “introductory design subjects” during the first year of architectural study. The comments also indicate that the standard colour theory text for Iranian architects is that of Itten, commonly taught in combination with making colour wheels with watercolours. For
Australian participants, except for one who mentioned Munsell, no mention was made of any specific author, book or colour theory.

Table 4.1: Results of yes/no and open-ended questions about architects’ colour training in their educational background

<table>
<thead>
<tr>
<th>Survey question</th>
<th>Yes</th>
<th>No</th>
<th>Year</th>
<th>Unit type</th>
<th>Info Type</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 In your University or College education and training was the study of colour part of your design course or curriculum?</td>
<td>Iran</td>
<td>30%</td>
<td>70%</td>
<td>First year</td>
<td>Itten's colour circle/ Book</td>
<td>Yes in both country: 31.6%</td>
</tr>
<tr>
<td></td>
<td>Australia</td>
<td>34%</td>
<td>65.7%</td>
<td>First year</td>
<td>Munsell 3%</td>
<td>No in both country: 68.4%</td>
</tr>
<tr>
<td>4.3 COLOUR KNOWLEDGE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It is hypothesised (H-4) that the colourfulness of architects’ designs increases as their colour knowledge increases. To test this hypothesis, the relationship between colour knowledge, specific colourfulness of designs and colourfulness of design portfolio was investigated. The results of preliminary analyses show violations of the assumption of normality, as colour knowledge and specific colourfulness of designs have non-normal distributions. Thus, to measure the strength and direction of the relationships between variables, a Spearman rank-order correlation, which is a non-parametric correlation coefficient alternative to Pearson’s correlation, was conducted (Table 4.2). The results show a significant positive correlation between colourfulness of design portfolio and specific colourfulness of designs (medium correlation, r=0.319, n=109, p<0.001). This means that the more colourful architects’ overall portfolios were, the more colourful were the two case-study designs they described. Moreover, there was a significant positive correlation
between colourfulness of design portfolio and colour knowledge (small correlation, \( r=0.282, n=109, p<0.005 \)). This means that the greater architects’ colour knowledge was, the more colourful their portfolios were.

**Table 4.2: Non-parametric correlation analysis – colour knowledge**

<table>
<thead>
<tr>
<th>Colour Knowledge</th>
<th>Colourfulness of Design Portfolio</th>
<th>Specific Colourfulness of designs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spearman’s rho</td>
<td>Correlation Coefficient</td>
<td>Correlation Coefficient</td>
</tr>
<tr>
<td>Colour Knowledge</td>
<td>1</td>
<td>.282**</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.003</td>
<td>.003</td>
</tr>
<tr>
<td>Colourfulness of Design Portfolio</td>
<td>.282**</td>
<td>1</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.003</td>
<td>.003</td>
</tr>
<tr>
<td>Specific Colourfulness of designs</td>
<td>.191*</td>
<td>.319**</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.046</td>
<td>.001</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).
c Listwise N=109

4.4 CULTURE

As stated in Section 2.3.3, to investigate comprehensively the relationship between colour and culture, two aspects of culture need to be considered: (1) cultural colour symbolism, association and value; and (2) colour orientation (preferences and attitudes), which consists of personal characteristics, demographics, psychological and biological conditions, cultural norms and perceived behavioural control. This section reports on the influence of cultural colour value, gender difference and country of origin (both Iran and Australia). Later, Sections 4.4.1 and 4.4.2 discuss the relationship between culture and colour orientation (preference and attitude).

As informed by the literature and pilot survey, it is hypothesised (H-2) that the cultural background of an architect affects their attitude to colour use when designing, their colour preference and overall colour use. This hypothesis consists of three sub-hypotheses that examine specific aspects in more detail: (H2-1) “Cultural background affects colour attitudes, preference and use”; (H2-2) “Colour
culture affects colour attitudes, preference and use”; and (H2-3) “Gender affects colour attitudes, preference and use”. A series of quantitative and qualitative analyses were conducted to test these hypotheses.

To test the first sub-hypothesis (H2-1), five individual multiple regression analyses were conducted to investigate the effects of: (1) country of practice; (2) country of childhood; (3) primary country of design education – undergraduate (Australia, Iran); and (4) country of postgraduate design education, in predicting five dependent variables extracted from three categories of colour attitude, colour preference and colour use (Figure 4.3).

Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity. From four predictor variables, only primary country of design education – postgraduate had a significant (p<0.05) zero-order correlation with perceived importance of colour to architecture. It has been found that the four-variable model of culture does significantly predict architects’ perceived importance of colour to architecture,
accounting for 3.6% of the variance, \( f(4, 265) = 2.5, p< 0.05 \), with primary country of design education – postgraduate accounting for the greatest variance. Moreover, it has been found that the four-variable model does not significantly predict architectural colourfulness preference, general colourfulness preference, colourfulness of design portfolio or specific colourfulness of designs.

To compare the score between the independent variables for country of practice, childhood, undergraduate and postgraduate education in Iran and Australia, a series of independent-sample t-tests were conducted for normally distributed variables (architectural colourfulness preference, general colourfulness preference, colourfulness of design portfolio). Chi-square and crosstab tests were used for the non-normal variables (perceived importance of colour to architecture, specific colourfulness of Designs \((1 + 2)\)).

An independent-sample t-test was conducted to compare the scores of architectural colourfulness preference for country of practice, childhood, undergraduate education and postgraduate education in Iran and Australia. There is a significant increase in scores from Iran \((M=6.97, SD=2.05)\) to Australia \((M=7.6, SD=2.34)\); \( t(229) = -2.11, p=0.036 \), two-tailed, for country of practice. The mean increase in country of practice scores is \(-0.62\) with a 95% confidence interval (CI) ranging from \(-1.2\) to \(-0.04\). The eta squared statistic \((0.019)\) indicates a very small effect size. However, no significant difference is found in scores for Iran and Australia for the other three cultural variables. The results of independent-sample t-tests for general colourfulness preference in Iran and Australia also show no significant difference in scores between the two countries for any of the four cultural variables.

Independent-sample t-tests were conducted to compare architectural colourfulness preference scores for Iran and Australia for four locations of cultural
indoctrination; country of: practice, childhood, undergraduate education and postgraduate education. Architectural colourfulness preference was rated from 1 (colourless) to 10 (highly colourful). Colourfulness scores are significantly higher when Australia is the country of practice – Iran (M=6.97, SD=2.05), Australia (M=7.6, SD=2.34); t(229)=−2.11, p=0.036, two-tailed. Thus, the mean scores are 0.62 higher for Australia, with a 95% CI ranging from −1.2 to −0.04. The eta squared statistic (0.019) indicates a very small effect size. No significant difference is found in architectural colourfulness preference scores for Iran and Australia for the other three cultural variables. The results of independent-sample t-tests for general colourfulness preference in Iran and Australia also show no significant difference in scores between the two countries for any of the four cultural variables.

Independent-sample t-tests comparing Iranian and Australian colourfulness of design portfolio scores for the same four cultural variables (country of practice, childhood, undergraduate education and postgraduate education) reveal a significant difference in scores between Iran (M=3.58, SD=1.2) and Australia (M=4.31, SD=1.4); t(106)=−2.8, p=0.006, two-tailed, for country of practice. Thus, the mean difference in country of practice scores is 0.726 higher (more colourful) for Australia, with a 95% CI ranging from −1.24 to −0.21. The eta squared statistic (0.065) indicates a large effect size. There is also a significant difference in scores between Iran (M=3.64, SD=1.2) and Australia (M=4.24, SD=1.3); t(96)=−2.31, p=0.023, two-tailed, for country of childhood and a significant difference in scores for country of undergraduate education – Iran (M=3.64, SD=1.2) and Australia (M=4.22, SD=1.3); t(100)=−2.33, p=0.022, two-tailed. The magnitude of the effect size for the differences in the means for country of childhood (mean difference = −0.6, 95% CI: −1.1 to −0.08) is medium (eta squared = 0.052) and for country of undergraduate education (mean difference = −0.6, 95% CI: −1.08 to −0.09) is
medium (eta squared = 0.051). No significant difference between Iran and Australia is found in scores for country of postgraduate education.

Chi-square and crosstab tests were used for testing the non-normal variables (perceived importance of colour to architecture, specific colourfulness of Designs (1 + 2). A chi-square goodness-of-fit test indicates no significant difference when comparing perceived importance of colour to architecture scores for country of: practice, childhood, undergraduate design education and postgraduate design education. However, the crosstab table shows that perceived importance of colour to architecture scores are significantly different for Australia and Iran for country of practice, country of childhood and country of undergraduate design education. While both countries have higher scores for Moderately important and Very important, Australians prefer more colourful architecture in comparison to Iran for all four cultural origin periods. A chi-square goodness-of-fit test indicates there is no significant difference between Iranian and Australian specific colourfulness of design scores for country of: practice, childhood, undergraduate design education or postgraduate design education. Moreover, the crosstab analysis repeats this result.

To test the impact of gender on colour attitude, preference and use (H2-2), an independent-sample t-test was conducted to compare scores of colourfulness attitude, perceived importance of colour to architecture, general colourfulness preference, colourfulness of design portfolio, and specific colourfulness of Designs (1 + 2) for men and women. Colourfulness attitude scores are significantly higher for women (M=7.6, SD=2.2) compared to men (M=7.02, SD=2.13); t(267)=2.21, p=0.028, two-tailed. The mean difference in colourfulness attitude scores is 0.58 with a 95% CI ranging from 0.06 to 1.1. The eta squared statistic (0.018) indicates a very small effect size. However, results show significantly lower perceived
importance of colour to architecture scores for women (M=0.13, SD=0.014) compared to men (M=0.18, SD=0.015); t(266)=−2.8, p=0.006, two-tailed, (mean difference = 0.6, 95% CI: −0.10 to −0.017) with a very small eta squared (0.028).

Colourfulness preference scores are significantly higher for women (M=4.53, SD=1.57) than for men (M=4.04, SD=1.49); t(259)=2.61, p=0.010, two-tailed. The mean difference in colourfulness preference scores is 0.49 with a 95% CI ranging from 0.121 to 0.866. The eta squared statistic (0.025) indicates a very small effect size.

Finally, colourfulness of design portfolio scores are significantly higher for women (M=4.28, SD=1.35) than for men (M=3.69, SD=1.27); t(117)=2.44, p=0.016, two-tailed. The mean difference in colourfulness of design portfolio scores is 0.59 with a 95% CI ranging from 0.11 to 1.06. The eta squared statistic (0.047) indicates a very small effect size. Although the results show significantly higher scores for women for the majority of the above variables, no difference was found between male and female scores for specific colourfulness of Designs (1+2).

To test the third sub-hypothesis (H2-3), gender affects colour attitudes, preference and use, the relationship was investigated between cultural background and two variables – perceived importance of colour to architecture and cultural potency of colour – and the relationship was investigated between individual colour orientation and use and four variables – general colourfulness preference, architectural colourfulness preference, specific colourfulness of designs and colourfulness of design portfolio. The results of preliminary analyses show violations of the assumption of normality, as perceived importance of colour to architecture and specific colourfulness of designs have non-normal distributions. Therefore, to measure the strength and direction of the association between variables, a non-parametric correlation coefficient or Spearman rank-order
correlation, which is an alternative to Pearson’s correlation, was conducted (Table 4.3).

The results show a significant positive correlation between the *cultural potency of colour* in an architect’s home *culture* and the architect’s *perceived importance of colour to architecture* (medium correlation, $r=0.429$, $n=105$, $p<0.000$) (Table 4.3). Thus, the more culturally important colour is in the home country, the more important colour is to architecture. There is a significant positive correlation between *general colourfulness preference* and *architectural colourfulness preference* (large correlation, $r=0.629$, $n=105$, $p<0.000$), *colourfulness of design portfolio* (large correlation, $r=0.503$, $n=105$, $p<0.000$) and *specific colourfulness of designs* (medium correlation, $r=0.308$, $n=105$, $p<0.001$). There is a significant positive correlation between *perceived importance of colour to architecture* and *specific colourfulness of designs* (small correlation, $r=0.285$, $n=105$, $p<0.005$). Thus, the more important colour is to architects, the more colourful are their designs. Moreover, there is a significant positive correlation between *specific colourfulness of designs* and *colourfulness of design portfolio* (medium correlation, $r=0.341$, $n=105$, $p<0.000$).
To investigate in more detail the influence of cultural background on colour choice, participants were asked to describe any colour biases in the visual culture of their home country and how this is reflected (if at all) in the built environment. Grounded theory has been used here as a codifying method to reveal the major themes. Table 4.4 and 4.5 display the nominated colour biases and their country of origin (Iran/Australia). The most dominant comments can be categorised into two main themes: (1) socio-cultural factors; and (2) contextual factors.

When Iranian participants talked about socio-cultural factors, they referred to these ideas: Islamic religion and culture, Persian culture, social norms, ethnic beliefs and government/political rules. According to the most numerous comments, the contextual factors of influence are climatic conditions, light intensity and use of
local materials. Due to their symbolic meanings and specific roles in Islamic religion and Persian culture, turquoise, green, black and azure blue were identified as the most common colour biases in Iranian visual culture and architecture:

Green, turquoise, blue, azure blue are the presentation of serenity and sanctity of space, which is used in religious and traditional architecture. These traditional colours mostly aim to remind the heavenly reality of things and their symbolic relation to god. (sample participant comment)

In Islamic culture, black is the colour of grief and mourning, and not only used as the colour of people’s clothing for special religious events but also transforms the city colourscape during religious events via the installation of black fabrics and flags on city walls. Comments suggested that in Iran the intensity of light and use of local soils for making materials, “reddish brown and cream colour of soil”, are the most dominant influences on colour choice for the built environment, especially in the desert regions. Moreover, comments reveal what were described as unwritten rules about the use of colour in traditional Iranian architecture related to the phenomenon of introversion in Iranian culture. Thus, traditional residential buildings were described as having a “plain and simple exterior with a variety of colourful decorations in interior spaces”, while religious buildings such as mosques and shrines were described as being adorned with tiles of turquoise and/or azure blue on domes and minarets, which can be seen from a distance especially in desert regions where most buildings are the colour of soil (Table 4.4).

Many Iranian participants claimed that, due to religious beliefs, cultural and ethnic norms and government preference, the use of vivid colours in society, especially for women’s clothing, and in particular red (a symbol of blood and evil), is generally seen as unacceptable. One of the participants believed that this attitude intensified after eight years of imposed war: “the restriction in use of colour has been a part of the lives of those who were born and lived during and after the war.
period. Avoiding vivid and bold colours and the use of dark and neutral colours became a part of people’s preference and choice around that time and has been intensified by its ignorance of social norms and political and government power”. Others claimed that this restriction is not just in relation to the visual culture of Iranian life but is also evident in the built environment because architects and designers wish “to avoid prejudice”.

Table 4.4: Emergent themes from Iranians’ comments about colour bias in their visual culture

<table>
<thead>
<tr>
<th>Themes</th>
<th>Socio-Cultural</th>
<th>Contextual</th>
<th>Socio-Cultural</th>
<th>Contextual</th>
<th>Socio-Cultural</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Government</td>
<td>Ethnics</td>
<td>Climate</td>
<td>Social norms</td>
<td>Local Material</td>
</tr>
<tr>
<td>IRAN</td>
<td>3</td>
<td>3</td>
<td>9</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

When Australian participants talked about socio-cultural factors, they referred to: sports and national patriotism, conservativism, Indigenous heritage, Western (Anglo-Saxon) and European culture. The most numerous contextual influences mentioned by Australian participants are: the natural environment/landscape, materials, light intensity and geographical conditions, and heritage (Table 4.5). The most common comments reveal that “grey,” “natural colours of materials”, “neutral colours” and “beige” are the dominant colours in Australian architecture and the built environment. It was also suggested that while the “earth-based and strong colours” of the Indigenous colour palette (black, red and yellow) are “deeply rooted with Indigenous culture, they [are] rarely and typically poorly applied to the built
environment”. Moreover, green, gold, blue, yellow, red and white were identified as colour biases in sports and national patriotism (colours of flags).

A number of participants suggested that the colours of the built environment “tend to mimic Western traditions and colours are mostly Modernist or a water-downed version of Postmodernism”. One commented: “generally there is not a very strong use of colour in Australian built environment”. Some suggested that Australians have a preference for “conservative colours” that “tends to reflect Australian heritage” and “Anglo-Saxon” origins. Although one participant suggested that “contemporary Melbourne architecture of the last twenty years is lime green”, the majority believed that neutral colours such as grey and beige are dominant. “Limited or lack of architects’ knowledge about colour choice” and choosing colours that are “safe to go” were explanations offered for the predominant greyness of the Australian built environment. In line with these views, another participant explained that “Robin Boyd coined the term ‘the Beige Australia policy’, a dual reference to Australia’s shameful White Australia immigration policy that ended in the 1960s and the Australian public’s preference for conservative colours in their suburban environments”. The intensity of light in Australia was also commonly suggested as an influential factor for the avoidance of vivid, strong colours and preference for neutral colours in the built environment.
As discussed in Section 2.3.3, architects may have different attitudes towards colour use for interior and exterior spaces, and these attitudes can vary between cultures. To investigate cultural differences towards interior and exterior colour use, participants were asked to describe their colour choice for the exteriors and interiors of the two case-study designs (Design-1 and Design-2) on 7 bipolar scales. Eight paired-sample t-tests were conducted to evaluate the difference between the use of colour from interior to exterior space in relation to country of origin (culture) and gender (male/female). The first sets of analyses, four paired-sample t-tests, were conducted to compare male and female colour use for: (1) interior of Design-1; (2) interior of Design-2; (3) exterior of Design-1; and (4) exterior of Design-2.

**Gender and interiors:** The results show no significant difference between male and female scores for the 7 bipolar adjectives describing the interiors of Design-1 and Design-2.

<table>
<thead>
<tr>
<th>Themes</th>
<th>Socio-Cultural</th>
<th>Contextual</th>
<th>Culture</th>
<th>Context</th>
<th>Culture</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUSTRALIA</td>
<td>European Culture</td>
<td>World cup culture</td>
<td>Western Angola</td>
<td>Saxon Culture</td>
<td>National Patriotism</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
Chapter 4: Analysis and Results

Gender and exteriors: The results of paired-sample t-tests show that women chose significantly lower scores on the exciting/calming scale (M=3.93, SD=1.86) than men (M=4.63, SD=1.44); t(102)=−2.14, p=0.035, two-tailed, for exterior spaces in Design-1. The mean increase in exciting/calming scores is −0.695 with a 95% CI ranging from −1.34 to −0.051. The eta squared statistic (0.043) indicates a small effect size. The analysis of scores for the 7 bipolar adjectives for exterior of Design-2 shows significantly higher scores for women on the harmonious/discordant (M=3.13, SD=1.62) compared to men (M=2.24, SD=1.5); t(71)=2.41, p=0.019, two-tailed, and on the pleasant/unpleasant scale (women M=3.00, SD=1.6; men M=2.17, SD=1.4; t(71)=2.35, p=0.021, two-tailed). The magnitude of the differences in the means for harmonious/discordant (mean difference = 0.881, 95% CI: 0.151 to 1.611) is moderate (eta squared = 0.075) and for pleasant/unpleasant (mean difference = 0.829, 95% CI: 0.128 to 1.53) is moderate (eta squared = 0.072).

The second set of four paired-sample t-tests were conducted to investigate the relationship between Iranian and Australian colour use for: (1) interior of Design-1; (2) interior of Design-2; (3) exterior of Design-1; and (4) exterior of Design-2.

Country of origin and interiors: The results show significantly lower scores on the comfortable/uncomfortable scale for Iran (M=2.12, SD=1.2) compared to Australia (M=2.76, SD=1.93); t(88.1)=−2.07, p=0.041, two-tailed, for interior of Design-1. The mean difference in comfortable/uncomfortable scores is −0.639 with a 95% CI ranging from 1.25 to −0.027. The eta squared statistic (0.046) indicates a small effect size. There are significantly higher scores on the spacious/confined scale for Iran (M=3.68, SD=1.9) compared to Australia (M=2.92, SD=1.7); t(107)=2.18, p=0.031, two-tailed, for interior of Design-1. The magnitude of the differences in the means (mean difference = 0.754, 95% CI: 0.069 to 1.44) is small.
Chapter 4: Analysis and Results

(eta squared = 0.042); No statistically significant differences are found between the two countries for the seven scales for the interior of Design-2. This is likely because the sample size (number of participants describing Design-2) is small.

Country of origin and exteriors: The results of paired-sample t-tests show significantly higher scores on the spacious/confined scale for Iran (M=3.70, SD=1.9) compared to Australia (M=2.67, SD=1.66); t(102)=2.91, p=0.004, two-tailed, for exterior of Design-1. The magnitude of the difference in the means (mean difference = 1.03, 95% CI: 0.327 to 1.73) is moderate (eta squared = 0.076).

Similarly, for exterior of Design-2 scores are significantly higher on the spacious/confined scale for Iran (M=3.70, SD=1.7) compared to Australia (M=2.66, SD=1.6); t(72)=2.7, p=0.009, two-tailed. The magnitude of the difference in the means (mean difference = 1.038, 95% CI: 0.273 to 1.804) is moderate (eta squared = 0.092). Scores are significantly lower for the exciting/calming scales for Iran (M=4.03, SD=1.53) than for Australia (M=4.83, SD=1.53); t(72)=2.23, p=0.029, two-tailed, for exterior of Design-2. The magnitude of the difference in the means (mean difference = −0.799, 95% CI: −1.513 to −0.085) is moderate (eta squared = 0.064).

4.4.1 COLOUR ORIENTATION

4.4.1.1 COLOUR PREFERENCE

The two variables of colour preference and colour attitude, indicating colour orientation, were used in a two-variable model to predict colour use. Thus, multiple linear regression analysis has been used to develop a model for predicting colourfulness of design portfolio and specific colourfulness of Designs (1+2) scores from architectural colourfulness preference scores and general colourfulness preference scores. Preliminary analysis was conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity. Each of
the predictor variables has a significant (p<0.001) zero-order correlation with both dependent variables. Using the enter method, it is found that architectural colourfulness preference and general colourfulness preference significantly predict actual colourfulness of design portfolio scores and specific colourfulness of Designs (1+2) scores. In model 1 (Table 4.3), the two-variable predictor model is able to account for 27.6% of the variance in colourfulness of design portfolio, $f(2, 114) = 21.744$, p<0.001. Of these two variables, neither predictor has significant partial effects in the full model, with colourfulness preference accounting for 2.69% of the variance and general colourfulness preference accounting for 0.85% of the variance.

In model 2 (Table 4.6), the two-predictor model is able to account for 11% of the variance in specific colourfulness of Design (1+2), $f(2, 129) = 8.02$, p<0.001. Of these two variables, general colourfulness preference makes the largest unique contribution (beta=0.252, $t(132)=2.45$), although architectural colourfulness preference also makes a statistically significant contribution (beta=0.332). Only general colourfulness preference has significant part effects in the full model, accounting for 4.12% of the variance.

### Table 4.6: Multiple regression analyses – colour orientation

<table>
<thead>
<tr>
<th>Model-1</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
<th>Zero-order</th>
<th>Partial</th>
<th>Part</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>1.806</td>
<td>.353</td>
<td>5.121</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colourfulness Preference</td>
<td>.274</td>
<td>.092</td>
<td>.316</td>
<td>2.978</td>
<td>.004</td>
<td>.487</td>
<td>.269</td>
</tr>
<tr>
<td>General Colourfulness preference</td>
<td>.145</td>
<td>.059</td>
<td>.261</td>
<td>2.462</td>
<td>.015</td>
<td>.469</td>
<td>.225</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model-2</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
<th>Zero-order</th>
<th>Partial</th>
<th>Part</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Constant)</td>
<td>.389</td>
<td>.057</td>
<td>6.805</td>
<td>.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colourfulness Preference</td>
<td>.033</td>
<td>.013</td>
<td>.252</td>
<td>2.450</td>
<td>.016</td>
<td>.319</td>
<td>.211</td>
</tr>
</tbody>
</table>
To explore the influence of participants’ colour preference on their colour choice and use (H-2), they were asked to nominate their favourite and least favourite colours. All colours nominated by more than 10% of participants have been categorised into different groups. Comments not containing any specific colour name or colours mentioned by less than 10% of participants have been eliminated from the analysis. Nominated colours have been categorised via two different approaches: (1) based on their hue, which resulted in ten main groups (red, green, blue, greyscale/achromatic colours (black, white, and grey), purple, yellow, brown, orange, context and others) that are common in both favourite and least favourite colours lists (although the list of least favourite colours has pink as one extra colour); and (2) based on their location in the colour wheel as warm or cold.

To explore participants’ colour preference, the relationship between participants’ favourite colour and least favourite colour has been examined. As both variables are categorical, a non-parametric test of chi-square was used. A chi-square test for independence (with Yates’ continuity correction) indicates that people who had warm least favourite colours had cold favourite colours, $X^2(4, n=137) = 10.52$, $p<0.033$, Cramer's $V=0.194$.

To investigate the association between gender and colour preference, chi-square and crosstab tests have been used. A chi-square test for favourite colours indicates that favourite colour choice did not significantly differ between genders, $X^2(9, n=252) = 8.12$, $p<0.522$. The results of the crosstab test show that both genders tended to choose cold colours as their favourites (Figure 4.4).
However, the results show that least favourite colour choice significantly differs between genders, $X^2(10, n=219) = 19.91$, $p<0.030$, Cramer’s $V = 0.06$. It also shows that both genders tended to choose warm colours as their least favourites (Figure 4.5).
Similar analyses investigated relationships between country of origin and colour preference. A chi-square test for *favourite colours* indicates that the choice of *favourite colour* is not significantly related to *country of childhood*, while the results of crosstab tests show that both countries have a higher score for *blue* and *green*. Moreover, it shows that both countries are more likely to elect *cold* colours as their *favourites* (Figure 4.6).
The analysis comparing *least favourite* colours in Iran and Australia shows that the choice of *least favourite* is significantly related to *country of childhood*. The crosstab table reveals that Australians are more likely to select *grayscale* and *neutral* colours, while Iranians are more likely to choose vivid and strong colours such as *purple*, *pink* and *yellow*. Both countries are most likely to choose *cold* colours as their *favourites* (Figure 4.7).

*Figure 4.6: Scores of Iranian and Australian participants for favourite colours; top diagram: based on nominated hues; bottom diagram: based on warm and cold categories of nominated colours*
To investigate the influence of colour preference on colour use in more detail, participants were asked to answer a yes/no question about the appearance of any dominant colours or hues in their designs. With 61.4% of participants stating they had some dominant colours in their designs, it seems that most architects consistently use the same specific colours or colour palettes.

As discussed in the literature review (Section 2.2.1), different genders may have different colour preference and attitude towards colours, which also might vary across cultures. The results of the comparison between participants’ answers to the appearance of any dominant colours in their designs reveal that, although both
genders have higher scores for Yes, female architects (with 62.9%) are more likely to have a dominant colour or colour palette for their designs.

Moreover, participants were asked to give further information about which colour or hue tends to dominate in their designs. Comparing comments between Iran and Australia reveals a marked difference between architects’ colour preferences in the two countries. As shown in Table 4.7, the three most commonly used colours in Iranian designs are the bright and vivid colours white, red and yellow, while the three most commonly used colours in Australia are grey, cream/beige and red. Figure 4.8 also reveals that, although the rest of the colours are mentioned approximately as often in the two countries, in Australia orange and green are the next most popular, while in Iran bright/vivid, warm colours and brown are more popular than the other colours.

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Q</th>
<th>IRAN</th>
<th>AUSTRALIA</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>(H-2) The cultural background of an architect impacts their attitude to colour use when designing, their colour preference and colour use.</td>
<td>Do any colours or hues tend to dominate?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White (14)</td>
<td>Grey (11)</td>
<td>White (8)</td>
<td>Grey (11)</td>
<td></td>
</tr>
<tr>
<td>Red (14)</td>
<td>Cream/Earthy/ Beige (10)</td>
<td>Red (9)</td>
<td>Cream/Earthy/ Beige (10)</td>
<td></td>
</tr>
<tr>
<td>Yellow (8)</td>
<td>White (8)</td>
<td>Yellow (8)</td>
<td>White (8)</td>
<td></td>
</tr>
<tr>
<td>Grey (7)</td>
<td>White (8)</td>
<td>White (8)</td>
<td>White (8)</td>
<td></td>
</tr>
<tr>
<td>Bright/Vivid colours (6)</td>
<td>Blue (6)</td>
<td>Blue (6)</td>
<td>Blue (6)</td>
<td></td>
</tr>
<tr>
<td>Warm colours (5)</td>
<td>Green (5)</td>
<td>Orange (5)</td>
<td>Orange (5)</td>
<td></td>
</tr>
<tr>
<td>Brown (5)</td>
<td>Black (5)</td>
<td>Black (5)</td>
<td>Black (5)</td>
<td></td>
</tr>
<tr>
<td>Black (5)</td>
<td>Natural (4)</td>
<td>Natural (4)</td>
<td>Natural (4)</td>
<td></td>
</tr>
<tr>
<td>Green (4)</td>
<td>Yellow (3)</td>
<td>Brown (2)</td>
<td>Brown (2)</td>
<td></td>
</tr>
<tr>
<td>Cream/Earthy/ Beige (4)</td>
<td>Natural (3)</td>
<td>Bright/ Vivid colours (2)</td>
<td>Bright/ Vivid colours (2)</td>
<td></td>
</tr>
<tr>
<td>Natural (3)</td>
<td>Orange (2)</td>
<td>Warm colours (1)</td>
<td>Warm colours (1)</td>
<td></td>
</tr>
<tr>
<td>Orange (2)</td>
<td>Purple (1)</td>
<td>........</td>
<td>........</td>
<td></td>
</tr>
<tr>
<td>Purple (1)</td>
<td>Silver (1)</td>
<td>........</td>
<td>........</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.7: Comparison of dominant colours and hues in architects’ designs in Iran and Australia
Results from the above analyses prompted a further question: Do architects who have more colourful buildings (designs) tend to use the dominant colours? To answer this question, an independent-sample t-test was conducted to compare the scores for colourfulness of design portfolio between participants who admitted to using a dominant colour or hue and those who did not. The results show no significant difference in colourfulness of design portfolio between those who claimed they use a dominant hue and those who did not.

4.4.1.2 COLOUR ATTITUDE

It is hypothesised (H-6) that of the general factors that inform an architect’s colour use (colour knowledge, culture, attitudes and preferences), architects will perceive that knowledge has the greatest impact. To test this hypothesis, the influence was investigated on colour use of five factors: (1) perceived impact of colour knowledge; (2) cultural background; (3) physical and cultural context; (4) client preference; and (5) attitude and preference. The results of preliminary analyses show a violation of the assumptions of normality, as physical and cultural context, client preference and attitude and preference in relation to colour use have non-normal distributions. However, the factor scores for the other two variables are normally distributed, as
assessed by the normality test (p>0.001) and by inspection of a boxplot where there are no outliers in the data.

Thus, a one-sample t-test was run to determine whether the score of two factors influencing colour use – perceived impact of colour knowledge and cultural background – are significantly different from a neutral point score, defined as 3.0 (Table 4.8). The results show a significant difference between the mean of perceived impact of colour knowledge (M=3.35 ± 1.16) and the neutral point score of 3.0, 0.35 (95% CI, 0.17 to 0.53), t(156)=3.8. However, there is no significant difference between the mean of perceived impact of cultural background and the neutral point score of 3.0.

A one-sample Wilcoxon signed-rank test, which is a non-parametric alternative to a one-sample t-test, was used for analysing the scores of the non-parametric variables perceived impact of physical and cultural context, client preference and attitude and preference on colour use. The test reveals that the null hypothesis has been rejected for all three variables, which means that the responses for these variables are significantly different to the expected value (neutral point of 3) p<0.000. The means of perceived impact of physical and cultural context (4.12 ± 0.92), perceived impact of client preference on designs (3.92 ± 0.87) and perceived impact of attitude on colour use (3.93 ± 0.85) are all higher than the neutral point score of 3.0.
Table 4.8: Comparison of five variables that may influence colour use with neutral point of 3.0

<table>
<thead>
<tr>
<th>Variables</th>
<th>Significant</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived impact of physical and cultural context of design (Mean=4.12)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Perceived Impact of attitudes and preferences on colour use (Mean=3.93)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Perceived Impact of client preference on design (Mean=3.92)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Perceived Impact of colour knowledge on colour use (Mean=3.35)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Perceived Impact of cultural background on colour use (Mean=3.14)</td>
<td>×</td>
<td></td>
</tr>
</tbody>
</table>

Neutral point (3.0)

It has been hypothesised (H-7) that architects will see that of the three general contexts for colour use (exteriors, interiors and landscapes), colour will be of most importance to interiors, which is augmented by sub-hypothesis (H7-1), the importance of colour use between interiors, exteriors and landscapes is different among architects. To test hypotheses (H-7) and (H7-1), the importance ratings of three contextual factors: (1) exterior; (2) landscape; and (3) interior colour to architecture have been investigated. The results of preliminary analyses show a violation of the assumptions of normality, as the importance of interior colour to architecture and the importance of landscape colour to architecture have non-normal distributions. However, the factor scores for the other variables are normally distributed, as assessed by the normality test (p>0.001) and there are no outliers in the data indicated by a boxplot.

Thus, a one-sample t-test determined whether mean scores for the importance of exterior colour to architecture are significantly different from the neutral point of 3.0 (Table 4.9). The results show that the mean for importance of exterior colour to architecture (M= 3.31± 1.44) is significantly higher than the neutral point, with
Chapter 4: Analysis and Results

a statistically significant difference of 0.311 (95% CI, 0.09 to 0.53), \(t(160)=2.73\), \(p=0.007\).

Moreover, one-sample Wilcoxon signed-rank tests were used for analysing the scores of the remaining non-parametric variables the importance of interior colour to architecture and the importance of landscape colour to architecture. The tests reveal that the null hypothesis was retained for the two variables, as the means for these variables are not significantly different to the neutral point of 3.0. The means of the importance of interiors colour to architecture \((3.16 \pm 1.6)\) and the importance of landscape colour to architecture \((3.19 \pm 1.4)\) are both higher than the neutral point score of 3.0.

Table 4.9: Comparison of importance of three context design variables in architects’ colour use with neutral point of 3.0

<table>
<thead>
<tr>
<th>H</th>
<th>Sub-H</th>
<th>Variables</th>
<th>Significant</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Importance of exterior colour to architecture</td>
<td>✓</td>
<td>It means that architects are agreed or strongly agreed that colour is an important consideration to building exterior (i.e., facades). It also means that colour is not an important consideration to buildings’ interior and landscape in architects’ point of view.</td>
</tr>
<tr>
<td>H-7</td>
<td>H7-1</td>
<td>Importance of landscape colour to architecture</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Mean=3.19)</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Importance of interior colour to architecture</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Mean=3.16)</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Neutral point (3.0)</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

According to H-3, architects’ colour use will vary between designs. To test this hypothesis, in the first step participants were asked to rate their level of agreement with the statement: For all of my designs, I normally stick to a similar colour palette, from 1 = Strongly disagree to 5 = Strongly agree). Although 34% said they Agree or Strongly agree with the statement, 40% said they Disagree/Strongly disagree and 26% rated their level of agreement as Neutral. As the mean of participants’ score for this statement (M=2.91) is lower than the Neutral
point score (3.0), it can be argued that architects’ colour use varies between their designs (Figure 4.9) but that the overall response to this question is close to the neutral position.

In the second step, participants rated their level of agreement with the statement: For each different design project, designers should try to use a strict colour palette that is informed by the specific urban context. Here (Table 4.10), 42% chose Disagree/Strongly disagree and 31% Neutral. With a mean score of 2.74, which is lower than the neutral point, it can be concluded that architects should not use a strict colour palette informed by context.

Review of these two questions suggests a possible contradiction, namely that colour use should vary between designs, but should not be informed by a context-related colour palette. In other words, it might be argued that the results for these two questions suggest that while colour use varies between designs, this variation is not informed by context. However, this reading should be treated with caution, as further explained in the Discussion section, because these scores might be informed by participants’ reactions to the word ‘strict’, which might imply a restriction that is too limiting for most architects.

Figure 4.9: Participants’ response to two questions testing (H-3): architects’ colour use will vary between designs
Table 4.10: Results of two questions aiming to test H-3

<table>
<thead>
<tr>
<th>Research question</th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q (5.9) For all of my designs, I normally stick to a similar colour palette</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Q (5.6) For each different design project, designers should try to use a strict colour palette that is informed by the specific urban context.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

In the third step of testing H-3, participants were asked to describe the colour palette of their nominated designs (Design-1 and Design-2) using 24 adjectives. A comparison of most selected adjectives in Design-1 and 2 shows that, although there are some differences in architects’ colour use between designs, it seems that in contrast to the hypothesis, architects’ colour use is largely consistent between

Figure 4.10: Scores for 24 adjectives selected by participants for describing their colour choice in Designs 1 and 2
designs. Results show that the adjectives *flamboyant, fashion, organisation style* and *climate sensitive* received the lowest scores in both Designs 1 and 2.

As many more answers were received for Design-1, to investigate the influence of gender and country of origin on architects’ use of colour in their design, just the selected adjectives for Design-1 have been analysed.

Although both genders have high scores for *context sensitive, beautiful* and *successful*, the results show a large difference between male and female descriptions of the colours they used. For instance, women have higher scores for *user* (score=27), *client driven* (score=23), *innovative* (score=19) and *cost-effective* (score=17), while men have higher scores for other adjectives such as *minimal* (score=26), *driven by personal taste* (score=23) and functional (score=22). Interestingly, *flamboyant* (score=1) is the least chosen adjective by both genders. It is also interesting to see that *climate sensitive*, identified in the literature as an important influence on colour choice, received a low score by both men and women (Figure 4.11).

![Figure 4.11: Difference between men and women in selecting from 24 adjectives for describing their use of colour in Design-1](image)

A comparison of adjective between Iran and Australia gives approximately similar results to gender. Both countries have higher scores for *beautiful, successful,*
context sensitive, minimal, functional, client driven and driven by personal taste, while lower scores belong to flamboyant and avante-garde. It is also interesting to see that climate sensitive received low scores in both countries (Figure 4.12).

Table 4.11 summarises the three analyses conducted to investigate differences in colour use between designs, genders and countries of origin (Iran/Australia) in descriptions of colour using the 24 adjectives.

Figure 4.12: Difference between Iranian and Australian participants in selecting from 24 adjectives for describing their use of colour in Design-1
## Table 4.11: Summary of three analyses for comparing selection of adjectives in (1) Design-1 vs Design-2; (2) men vs women; and (3) Iran vs Australia

<table>
<thead>
<tr>
<th>Design 1 &amp; Design 2</th>
<th>Gender &amp; Design 1</th>
<th>Country &amp; Design 1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td><strong>Design 1</strong></td>
<td><strong>Design 2</strong></td>
<td><strong>Male</strong></td>
</tr>
<tr>
<td>Exemplars (99)</td>
<td>Climate sensitive (37)</td>
<td>Beautiful (31)</td>
</tr>
<tr>
<td>Context sensitive (56)</td>
<td>Minimal (26)</td>
<td>Minimal (20)</td>
</tr>
<tr>
<td>Successful (51)</td>
<td>Functional (34)</td>
<td>Successful (25)</td>
</tr>
<tr>
<td>Thoughtful (44)</td>
<td>Conservative (32)</td>
<td>Thoughtful (25)</td>
</tr>
<tr>
<td>User (44)</td>
<td>Avant-garde (32)</td>
<td>Driven by personal taste (23)</td>
</tr>
<tr>
<td>Minimal (42)</td>
<td>User (32)</td>
<td>Functional (22)</td>
</tr>
<tr>
<td>Functional (40)</td>
<td>Theoretical (24)</td>
<td>User (17)</td>
</tr>
<tr>
<td>Client driven (39)</td>
<td>Beautiful (24)</td>
<td>Conservative (15)</td>
</tr>
<tr>
<td>Driven by personal taste (39)</td>
<td>Innovative (24)</td>
<td>Client driven (15)</td>
</tr>
<tr>
<td>Innovative (35)</td>
<td>Minimal (22)</td>
<td>Exemplars (15)</td>
</tr>
<tr>
<td>Cost effective (33)</td>
<td>Context sensitive (20)</td>
<td>Cost effective (14)</td>
</tr>
<tr>
<td>Conservative (27)</td>
<td>Safe (20)</td>
<td>Innovative (14)</td>
</tr>
<tr>
<td>Theoretical (25)</td>
<td>Driven by personal taste (19)</td>
<td>Theoretical (14)</td>
</tr>
<tr>
<td>Well trialled (20)</td>
<td>Client driven (15)</td>
<td>Adventurous (11)</td>
</tr>
<tr>
<td>Adventurous (18)</td>
<td>Cost effective (14)</td>
<td>Safe (11)</td>
</tr>
<tr>
<td>In the organizational style (16)</td>
<td>Adventurous (13)</td>
<td>Avant-garde (9)</td>
</tr>
<tr>
<td>Avant-garde (15)</td>
<td>Exemplars (12)</td>
<td>Climate-sensitive (6)</td>
</tr>
<tr>
<td>Climate sensitive (11)</td>
<td>In the organizational style (5)</td>
<td>Well trialled (6)</td>
</tr>
<tr>
<td>Flamboyant (4)</td>
<td>Flamboyant (1)</td>
<td>Flamboyant (2)</td>
</tr>
</tbody>
</table>
For elucidating architects’ attitude towards colour use in their designs in more
detail, they were asked to rate the importance of four functions of colour to their
design process on a 5-point Likert-scale (from 1 = Not at all to 5 = Very important).
Results (Table 4.12) show that architects rated colour use as applied decoration the
least important (M=3.61, SD=15.6), with integral to design concept the next highest
(M=3.59, SD=18.34). Rated as greater than moderately important functions are to
courage a psychological/emotional responses (M=4.16, SD=31.2) and then to
contrast or blend design to its content (M=4.17, SD=32).

Table 4.12: Importance of four functions of colour in architects’ design process

<table>
<thead>
<tr>
<th>Variables</th>
<th>Not at all</th>
<th>Minimally important</th>
<th>Somewhat</th>
<th>Moderately important</th>
<th>Very important</th>
</tr>
</thead>
<tbody>
<tr>
<td>As applied decoration</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td>Mean= 3.61</td>
</tr>
<tr>
<td>integral to design concept</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mean= 3.59</td>
</tr>
<tr>
<td>to contrast or blend a design to its context</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mean= 4.17</td>
</tr>
<tr>
<td>to encourage a psychological/emotional response</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mean= 4.16</td>
</tr>
</tbody>
</table>

4.5 PRACTICE

As discussed in Section 3.4 (Variable refinement), the practice variables are related to
two main areas: (1) people/professionals; and (2) context. Thus, the following
discussion of colour use in practice is split into these two areas.

4.5.1 PEOPLE/PROFESSIONALS

To compare the perceived and actual influences of context to those of urban/interior
designers, architects, clients, LPA and colour consultants, a series of analyses were
performed to test a number of related hypotheses.

It is hypothesised (H5-A) that of the multiple influences on the use of colour in
built environment design (architects, clients, LPA, urban designer, colour
consultant, and design context), architects will perceive that only the client and
design context are significant. To test this hypothesis, first the influence of six factors on colour use were investigated: (1) perceived influence of architect; (2) physical and cultural context of design; (3) client; (4) LPA; (5) urban designer; and (6) colour consultant. The results of preliminary analyses show violations of the assumption of normality, as perceived influence of architects and physical and cultural context of design have non-normal distributions. The factor scores for the other four variables are normally distributed as assessed by a normality test (p>0.001) and a boxplot indicating no outliers.

Accordingly, a one-sample t-test was run to determine whether the score of four factors – perceived influence of client, LPA, urban designer and colour consultant – are different to a neutral point defined as a score of 3.0 (Table 4.13). The results show that there is a significant difference between the mean of perceived influence of client (M= 3.8± 0.91), LPA (3.4 ± 1.14) and urban designer (3.4 ± 1.2), which are all higher than the neutral point score of 3.0, with statistically significant differences of 0.81 (95% CI, 0.65 to 0.97), t(124)=9.9, p=0.000; 0.40 (95% CI, 0.18 to 0.6), t(121)=3.61, p=0.000; and 0.41 (95% CI, 0.21 to 0.61), t(123)=4 , p=0.000. However, no significant difference has been found between the mean of perceived influence of colour consultant (M=3.1) and the neutral point.

A one-sample Wilcoxon signed-rank test, which is a non-parametric alternative to a one-sample t-test, was used for analysing the score of the two remaining non-parametric variables perceived influence of architects and physical and cultural context influencing colour use. The test reveals that the null hypothesis has been rejected for both variables, which means that the responses to these variables are significantly different to the expected value, the neutral point of 3, p<0.000. Moreover, the test of variable means determines that the means of perceived influence of architect
(4.36 ± 0.80) and perceived impact of the physical and cultural context of design (4.12 ± 0.92) are significantly higher than the neutral point score of 3.0.

Table 4.13: Comparison of six variables that may influence colour use with neutral point of 3.0

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Sub-hypothesis</th>
<th>DV</th>
<th>Significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>(H-5-A) Of the multiple influences on the use of colour in built environment design (Architects, Clients, LPA, Urban Designer, Colour Consultant, and Design Context), Architects will perceive only the client and the design context are significant</td>
<td>Architect (non-parametric) (Mean= 4.36)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Perceived impact of physical and cultural context of design (non-parametric) (Mean= 4.12)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Client (Mean= 3.8)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LPA (Mean= 3.41)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Urban designer (Mean=3.4)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Colour consultant (Mean= 3.1)</td>
<td>✗</td>
<td></td>
</tr>
</tbody>
</table>

Neutral point (3.0)

To inform investigation of the actual influences of: (1) architectural team; (2) physical and cultural context of design; (3) client; (4) interior designer; and (5) LPA on architects’ colour use, it is hypothesised (H5-B) that of the multiple influences on an architect’s actual colour use (architects, clients, LPA, interior designer and design context), only the architect, client and the designs context will be significant. The results of preliminary analyses show violations of the assumption of normality, as specific influence of architectural team and physical and cultural context of design on colour use have non-normal distributions. However, the factor scores for the other three variables are normally distributed, as assessed by a normality test (p>0.001) and no outliers in the data as indicated by a boxplot.

Thus, a one-sample t-test was run to determine whether the score of three factors, the specific/actual influence of client, interior designer and LPA on colour use, are different to a neutral point defined as a score of 3.0 (Table 4.8). The results reveal that the mean of specific influence of client (M=3.6± 1.16) is significantly higher than the neutral point score of 3.0, with a statistically significant difference of 0.6 (95% CI,
0.38 to 0.8), t(132)=5.8, p=0.000. However, the means of specific impact of LPA (2.27± 1.26) and specific impact of interior designer (2.49± 1.63) are lower than the neutral point score of 3.0, with statistically significant differences of −0.73 (95% CI, −0.95 to −0.51), t(131)=−6.7, p=0.000; and −0.51 (95% CI, −0.8 to −0.23), t(131)=−3.6, p=0.000.

A one-sample Wilcoxon signed-rank test was used for analysing the scores of the remaining two non-parametric variables – specific influence on colour use of architectural team and physical and cultural context of design. The test reveals that the null hypothesis has been rejected for both variables, which means the responses to this variable are significantly different to the expected neutral point value of 3.0, p<0.000. Moreover, the test of variable means determines that the means of specific impact of architectural team (4.13 ± 1.23) and perceived impact of context (4.12 ± 0.92) are significantly higher than the neutral point score of 3.0.

Table 4.14: Comparison of five variables that may influence colour use with neutral point of 3.0

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Sub-hypothesis</th>
<th>DV</th>
<th>Significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>(H-5-B) Of the multiple influences on an architectural outcome (Architects, Clients, LPA, Urban Designer, Colour Consultant and Design Context), only the Architect, client and the Design context will have been significant.</td>
<td>Architectural team (non-parametric) (Mean= 4.13)</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>(H-5-B-1) Difference in influence on actual colour use between Architects, Clients, LPA, Urban Designer, Colour Consultant, and Design Context</td>
<td>Perceived impact of physical and cultural context of design (non-parametric) (Mean= 4.12)</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Client (Mean= 3.6)</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Neutral point (3.0)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interior designer (Mean= 2.48 )</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td></td>
<td>LPA (Mean= 2.27)</td>
<td>✔️</td>
<td></td>
</tr>
</tbody>
</table>

To investigate the perceived influence of people/professionals and contextual factors in more detail (H-5-A & B), participants were asked to nominate any other factors or people/professionals influencing the colour of the built environment not
previously mentioned in the survey. Grounded theory has been used as a codifying method to reveal the major themes from responses to this open-ended question. According to the most dominant comments, clients and space users, with 25% of the scores, material importer/supplier/dealers (15%) and artists/painters (13%) are the most influential factors on colour use (Figure 4.13).

In addition, a number of new factors were suggested by participants such as advertisers/marketers (6%), media (social media, TV programs), design journals, real estate agents and digital sign and lighting designers. The influence of education on colour use, which consists of “knowledge of teachers not only in graduate and postgraduate level but also in primary school”, as well as the importance of “adding colour training to architectural curriculum”, was identified by 4% of the comments.

4.5.2 CONTEXT

The analyses reported in this section are related to those hypotheses that focus on the use of colour in design in relation to contextual factors. For instance, it is hypothesised (H-3) that architects’ colour use will vary between their designs. This hypothesis consists of two sub-hypotheses that allow for testing in more detail. To
test H3-1, comparison of colourfulness between designs according to the design context, a paired-sample t-test was conducted to evaluate the difference between the colourfulness of Design-1 and Design-2. The results show no statistically significant change in colourfulness from Design 1 (M=3.71, SD=1.38) to Design 2 (M=3.52, SD=1.29), t(20)=0.640, with the mean decrease 0.19.

The second sub-hypothesis (H3-2) focuses on the difference between effects of design context factors from Design-1 to Design-2. To test this sub-hypothesis, a paired-sample t-test was conducted to evaluate the difference between the effects of 19 design context factors from Design-1 to Design-2. The results show a statistically significant decrease in perception of space scores from Design-1 (M=3.87, SD=1.077) to Design-2 (M=3.59, SD=1.192); t(91)=2.287, p<0.0005 (two-tailed). The mean decrease in perception of space scores is 0.275 with a 95% CI ranging from 0.036 to 0.513. The eta squared statistic (0.028) indicates a small effect size. This means that the use of colour for each design is different based on the perception of space in each specific design. However, there is no significant change from Design-1 to Design-2 in the impact of the remaining 18 factors.

In addition, a one-sample t-test was run to determine whether the scores of the 19 contextual factors influencing colour use are different from a neutral point defined as a score of 3.0 (Table 4.15). The test also elucidates how architects use colour differently between designs. The factor scores are normally distributed in both designs, as assessed by a normality test (p>0.001), and there were no outliers in the data as indicated by inspection of a boxplot. The results reveal that in both designs the means of typology, space perception, stand/blend and psychological impact are significantly higher than the neutral point score of 3.0, which means these factors moderately or highly influence the colour choice of multiple designs. However, only in Design-1 are the means of building form and natural features
significantly higher than the neutral point. Moreover, the results reveal that the means of neighbouring building, urban planning restriction, prominent buildings and safety coding are significantly lower than the neutral point score of 3.0 in both designs, which means these factors are not at all or minimally considered in the colour choice of designs. However, no significant difference has been found in both designs between the means of the remaining factors and the neutral point.

Table 4.15: Comparison of importance of 19 variables in Designs 1 and 2 with neutral point of 3.0

<table>
<thead>
<tr>
<th>Significant</th>
<th>DESIGN 1 (19 variables)</th>
<th>DESIGN 2 (19 variables)</th>
<th>Significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Typology (Mean= 3.73)</td>
<td>Typology (Mean= 3.80)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>✓ Space perception (Mean= 3.73)</td>
<td>Stand/blend (Mean= 3.67)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>✓ Stand/blend (Mean= 3.68)</td>
<td>Space perception (Mean= 3.62)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>✓ Psychological impact (Mean= 3.48)</td>
<td>Psychological impact (Mean= 3.44)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>✓ B. form (Mean= 3.36)</td>
<td>B. form (Mean= 3.23)</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>✓ Natural features (Mean= 3.36)</td>
<td>Natural features (Mean= 3.13)</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>× Climate (Mean= 3.16)</td>
<td>Historical context (Mean= 3.07)</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>× Light (Mean= 3.12)</td>
<td>Urban density (Mean= 3.05)</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>× Night (Mean= 3.02)</td>
<td>Night (Mean= 3.00)</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>× Urban density (Mean= 2.92)</td>
<td>Light (Mean= 2.97)</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>× Wayfinding (Mean= 2.90)</td>
<td>Wayfinding (Mean= 2.90)</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>× Historical context (Mean=2.86)</td>
<td>B. height (Mean= 2.82)</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>× Cultural context (Mean= 2.86)</td>
<td>Climate (Mean= 2.80)</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>× B. height (Mean= 2.85)</td>
<td>Neighbouring building (Mean= 2.78)</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>× B. orientation (Mean= 2.81)</td>
<td>B. orientation (Mean= 2.73)</td>
<td>×</td>
<td></td>
</tr>
<tr>
<td>✓ Neighbouring building (Mean= 2.73)</td>
<td>Urban planning restriction (Mean= 2.70)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>✓ Urban planning restriction (Mean= 2.57)</td>
<td>Cultural context (Mean= 2.62)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>✓ Prominent. B (Mean= 2.54)</td>
<td>Prominent building (Mean= 2.48)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>✓ Safety coding (Mean= 2.12)</td>
<td>Safety coding (Mean= 2.23)</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

In order to further elucidate the differential influences of the 19 contextual factors between the two designs, the data reduction technique of factor analysis (FA)
has been used to reduce the 19 factors to a smaller number of factor sets. FA provides an opportunity to simplify investigation of how architects vary colour between designs by grouping together those of the 19 factors that exert similar influence. According to Pallant (2016), there are three main steps in conducting factor analysis: (1) assessment of the suitability of the data for factor analysis, which is related to sample size and the strength of the relationship between the variables; (2) factor extraction; and (3) factor rotation and interpretation.

As all 19 contextual factors are related to one larger variable, which is colour use, maximum likelihood analysis (MLA) has been used as an extraction technique to maximise the probability of finding factors from the population. Prior to performing MLA, the suitability of the data for factor analysis was assessed through inspection of the correlation matrices for both Design-1 and Design-2 to identify correlation coefficients of 0.3 and above. While there is little agreement among different authors concerning how large a sample should be, some suggest the sample size needs to be at least 300 cases, while others concede that a smaller sample size or around 150 cases is sufficient if solutions have several high-loading marker variables (above 0.80). It is also suggested that the factors obtained from small data sets do not generalise as well as those derived from larger samples. Moreover, some authors believe that the ratio of participants is more important than the sample size; for instance, according to Tabachnick and Fidell (2007, p. 618), five cases for each item are adequate in most cases. The number of cases in both Design-1 and Design-2 is less than 150: Design-1 = 122 and Design-2 = 85. However, the ratio is sufficient for all factors of each design. Factor rotation and interpretation have been decided based on these results.

- **FACTOR ANALYSIS – DESIGN-1**
For Design-1, the 19 4-point Likert-scale items influencing colour use were subjected to MLA using SPSS. Prior to performing MLA, the suitability of the data for factor analysis was assessed. Inspection of the correlation matrix for Design-1 reveals that all 19 coefficients are 0.3 and above. The Kaiser–Meyer–Olkin value is 0.85, exceeding the recommended value of 0.6 (Kaiser 1970, 1974), and Bartlett’s test of sphericity (Bartlett 1954) reaches statistical significance, supporting the factorability of the correlation matrix. The maximum likelihood analysis reveals the presence of five factors with eigenvalues exceeding 1, explaining 15.9%, 14.11%, 12%, 7.9% and 5.25% of the variance, respectively. While inspection of the scree plot reveals a clear break after the second factor, suggesting two factors could be extracted if the need was to simplify the analysis as much as possible, due to the small sample size and the need to find a solution elucidating the complex relationship between variables, the number of factors extracted is based on the eigenvalues i.e. 5.

After five factors were extracted, the five-factor solution explains a total of 55.28% of the variance, with factor 1 contributing 16%, factor 2 contributing 14.11%, factor 3 contributing 12%, factor 4 contributing 7.9% and factor 5 contributing 5.25%. These five factors have eigenvalues of 6.87, 1.9, 1.48, 1.12 and 1.07, respectively. To aid in the interpretation of these five factors, Varimax rotation (a type of orthogonal rotation) was performed. The rotated solution reveals the presence of a simple structure (Thurstone 1947), with the five factors showing a number of strong loadings and all variables loading substantially onto at least one component, but not onto more than two components.

As the 19 component variables have not been tested in any previous study, this five-factor clustering is novel. However, it can be considered that due to the small sample size, the result of this technique cannot be generalised. As some factors
load at greater than 0.3 onto two components, the 19 variables can be loaded onto alternative components to allow for greater theoretical consistency between the variables of each component. Table 4.16 shows the final loadings for each of the five factors: (1) solar access, (2) urban context, (3) perception, (4) legislative restriction, and (5) building prominence. Here, factor 1, solar access, represents a combination of building orientation, light, climate and building height. Factor 2, urban context, consists of neighbouring building, prominent building, historical context, natural features and urban density. Factor 3, perception, consists of psychological impact, colour in night, wayfinding, space perception, cultural context and typology. Factor 4, legislative restriction, consists of urban planning restriction and safety coding; and finally factor 5, prominence, consists of building form and stand/blend in the context.

Table 4.16: Interpretation of extracted factors from rotated factor matrix for Design-1 (rotation method: Varimax with Kaiser normalisation)
**FACTOR ANALYSIS – DESIGN-2**

For Design-2, the 19 component variables of *colour use* were subjected to MLA using SPSS. Prior to performing MLA, the suitability of the data for factor analysis was assessed. Inspection of the correlation matrix for Design-2 reveals that all 19 coefficients are 0.3 and above. The Kaiser–Meyer–Olkin value is 0.8, exceeding the recommended value of 0.6 (Kaiser 1970, 1974), and Bartlett’s test of sphericity (Bartlett 1954) reaches statistical significance, supporting the factorability of the correlation matrix. The maximum likelihood analysis reveals the presence of five factors with eigenvalues exceeding 1, explaining 37.8%, 10.16%, 8.7%, 8.3% and 5.7% of the variance, respectively. While inspection of the scree plot reveals a clear break after the second factor, suggesting two factors could be extracted, again due to the small sample size and the need to find a solution elucidating the complex relationship between variables, the number of factors extracted is based on the eigenvalues i.e. 5.

After five factors were extracted, the five-factor solution (combining the five extracted factors) explains a total of 60.74% of the variance, with factor 1 contributing 16%, factor 2 contributing 14.7%, factor 3 contributing 13%, factor 4 contributing 9.7% and factor 5 contributing 7.3%. These five factors have eigenvalues of 7.2, 1.9, 1.6, 1.58 and 1.08, respectively. To aid in the interpretation of these five components, Varimax rotation was performed. The rotated solution reveals the presence of a simple structure (Thurstone 1947), with the five factors

<table>
<thead>
<tr>
<th>Legislative restriction</th>
<th>Urban planning restriction</th>
<th>Safety coding</th>
<th>Prominence</th>
<th>B. form</th>
<th>Stand/blend</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.334</td>
<td>.609</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.352</td>
<td>.368</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.451</td>
<td>.411</td>
</tr>
</tbody>
</table>
again showing a number of strong loadings and all variables loading substantially onto at least one component, but not onto more than two components.

As some factors load at greater than 0.3 onto more than one component, the 19 variables can be loaded onto alternative components to allow for greater theoretical consistency between the variables of each component. Table 4.17 shows the final loadings for each of the five factors: (1) visibility–physical/cultural context, which is a combination of light, safety coding, climate, cultural context, wayfinding, space perception and natural features; (2) morphology, consisting of building form, building height and building orientation; (3) relationship with neighbouring buildings, consisting of neighbouring buildings, prominent buildings and historical context; (4) building prominence, consisting of colour in night, psychological impact and stand/blend in the context; and (5) urban context, consisting of urban density, typology and urban planning restriction.

Table 4.17: Interpretation of extracted factors from rotated factor matrix for Design-2 (rotation method: Varimax with Kaiser normalisation)

<table>
<thead>
<tr>
<th>New factors</th>
<th>Design-2 19 variables</th>
<th>Rotated factor matrix</th>
<th>Rotation method: Varimax with Kaiser normalisation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Visibility–physical/cultural context</td>
<td>Light</td>
<td>.742</td>
<td>.509</td>
</tr>
<tr>
<td></td>
<td>Safety coding</td>
<td>.634</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Climate</td>
<td>.622</td>
<td>.493</td>
</tr>
<tr>
<td></td>
<td>Cultural context</td>
<td>.615</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wayfinding</td>
<td>.575</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Space perception</td>
<td>.505</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Natural features</td>
<td>.342</td>
<td>.308</td>
</tr>
<tr>
<td>Morphology</td>
<td>B. form</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. height</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>B. orientation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relationship with neighbouring buildings</td>
<td>Neighbouring buildings</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prominent buildings</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Historical context</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
As the literature suggests that architects usually have a different approach towards the use of colour for interior space in comparison to exterior space, a four paired-samples t-test was conducted to evaluate the difference between the uses of colour from *interior* to *exterior space* in both designs. The analysis was done in four steps: (1) *interior* vs *exterior* for Design-1; (2) *interior* vs *exterior* for Design-2; (3) *interior* in Design-1 vs Design 2; and (4) *exterior* in Design-1 vs Design 2.

The first paired-sample t-test was conducted to evaluate the difference between the uses of colour from *interior* to *exterior* in Design-1. The variables compared were 7 bipolar adjectives describing the colours chosen. The results show a statistically significant decrease in *harmonious/discordant* scores from Design-1 (M=2.69, SD=1.71) to Design-2 (M=2.30, SD=1.56), t(97)=1.99, p=0.049 (two-tailed), and *introverted/extroverted* scores from Design-1 (M=4.11, SD=1.62) to Design-2 (M=3.66, SD=1.64), t(93)=2.49, p=0.015 (two-tailed). The mean difference in *harmonious/discordant* scores is 0.398 with a 95% CI ranging from 0.001 to 0.795. The eta squared statistic (0.039) indicates a small effect size. Moreover, the mean decrease in *introverted/extroverted* scores is 0.447 with a 95% CI ranging from 0.091 to 0.803. The eta squared statistic (0.06) indicates a moderate effect size.

A second paired-sample t-test was conducted to evaluate the difference between colour uses from *interior* to *exterior* in Design-2. The results reveal that

<table>
<thead>
<tr>
<th>Prominence</th>
<th>Night</th>
<th>Psychological impact</th>
<th>Stand/blend</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>.696</td>
</tr>
<tr>
<td>Urban context</td>
<td></td>
<td></td>
<td>.695</td>
</tr>
<tr>
<td>Urban density</td>
<td>.307</td>
<td>.310</td>
<td>.474</td>
</tr>
<tr>
<td>Typology</td>
<td>.326</td>
<td>.342</td>
<td>.489</td>
</tr>
<tr>
<td>Urban planning restriction</td>
<td>.385</td>
<td></td>
<td>.413</td>
</tr>
</tbody>
</table>
there is no statistically significant difference between the use of colour in the exterior and interior of Design-2.

The third test was run to compare colour use in the interior of Design-1 to that in the interior of Design-2. The results show a statistically significant decrease in exciting/calming from the interior of Design-1 (M=4.63, SD=1.81) to Design-2 (M=4.11, SD=1.82), t(69)=2.03, p=0.046 (two-tailed). The mean increase in exciting/calming scores is 0.514 with a 95% CI ranging from 0.01 to 1.02. The eta squared statistic (0.056) indicates a small effect size.

The last paired-sample t-test aimed to compare colour use in the exterior of Design-1 to that in the exterior of Design-2. The results reveal a statistically significant increase in harmonious/discordant scores from Design-1 (M=2.15, SD=1.42) to Design-2 (M=2.55, SD=1.53), t(65)=−1.84, p=0.07 (two-tailed), and pleasant/unpleasant scores from Design-1 (M=2.20, SD=1.56) to Design-2 (M=2.53, SD=1.51), t(65)=−2.114, p=0.038 (two-tailed). The mean increase in harmonious/discordant scores is −0.394 with a 95% CI ranging from −0.821 to 0.033. The eta squared statistic (0.05) indicates a small effect size. However, the mean increase in pleasant/unpleasant scores is −0.333 with a 95% CI ranging from −0.648 to −0.018. The eta squared statistic (0.064) indicates a moderate effect size.

To obtain more detailed information, participants were asked to explain the reasons for and influential factors on their colour use for their designs. Grounded theory has been used as a codifying method to reveal the major themes from comments given to this open-ended question (Figure 4.14). The most dominant comments suggest that context, client’s preference and materials and building function are respectively the most, and architectural styles, concept, restriction rules and similar examples are the least, influential factors on their colour use. However, choosing a colour to make the design bold/attractive, use of colour based on
personal preference, psychological influence, the company style, budget and a colour palette which is safe and easy to use were other reasons given that have moderate influence on participants’ colour choices for their nominated designs (Designs 1 and 2).

Figure 4.14: Influential factors and reasons behind architects’ colour choice for Designs 1 and 2

4.6 SUMMARY

The following several pages present a summary of all analyses in five tables that are categorised based on the main variables and the aims of the thesis – the influences of: (1) education (Table 4.18); (2) colour knowledge (Table 4.19); (3) colour orientation including colour preference and attitude towards colour (Table 4.20); (4) culture (Table 4.21); and (5) context including people and place/context (Table 4.22). This also reveals the relationships between each hypothesis and the type of analysis that has been used based on the variables. The result of the analyses are also briefly presented in a separate column in each table.
Table 4.18: Summary of all analyses and results for testing influence of education on architects' colour choice and use.

<table>
<thead>
<tr>
<th>Education</th>
<th>IV</th>
<th>Method</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DV</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Thoroughness of Colour Theory Education (C)</td>
<td>1. Thoroughness of Colour Theory Education (C)</td>
<td>Yes</td>
<td>Colour education significantly impacts DV. But only Colour Theory education can significantly predict Colour Knowledge in the model.</td>
</tr>
<tr>
<td>2. Thoroughness of Colour Practice Education (C)</td>
<td>2. Thoroughness of Colour Practice Education (C)</td>
<td>No</td>
<td>Colour Education cannot significantly predict Architectural Colourfulness Preference.</td>
</tr>
<tr>
<td>1. Thoroughness of Colour Theory Education (C)</td>
<td></td>
<td></td>
<td>Colour education significantly impacts DV. But neither variable can significantly predict Perceived Importance of Colour to Architecture in the model.</td>
</tr>
<tr>
<td>2. Thoroughness of Colour Practice Education (C)</td>
<td></td>
<td></td>
<td>Colour Education does not influence General Colourfulness Preference.</td>
</tr>
<tr>
<td>2. Thoroughness of Colour Practice Education (C)</td>
<td></td>
<td></td>
<td>Colour Education does not influence colourfulness of portfolio</td>
</tr>
<tr>
<td>1. Thoroughness of Colour Theory Education (C)</td>
<td></td>
<td></td>
<td>Colour Education does not influence colourfulness of built designs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Unit type</th>
<th>Info Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Predominantly receive training</td>
<td>Unit type</td>
</tr>
</tbody>
</table>

| Iran | 30% | 70% | During first year of study | Basic initial architectural units 54% | Graphic & presentation 14% | Design studio 36% | Excel (percentage) | Yes in both country: 31.6% |
| Australi a | 34% | 65.7% | During first year of study | Muncell 3% | Colour wheel/ theory 16% | Exercise- Water colour 5% | Emotional interpretation 3% | No in both country: 68.4% |
### Table 4.19: Summary of analysis and results related for testing influence of colour knowledge on architects’ colour choice and use

<table>
<thead>
<tr>
<th>Colour Knowledge</th>
<th>Hypothesis</th>
<th>IV</th>
<th>Colour Knowledge</th>
<th>DV: Colourfulness of Design Portfolio</th>
<th>DV: Specific Colourfulness of Designs (1 + 2 Combined)</th>
<th>Method</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour Knowledge</td>
<td>(H-4) the colourfulness of architects’ designs increases as architects’ colour knowledge increases</td>
<td>1</td>
<td>.282**</td>
<td>.191</td>
<td>Pearson correlation</td>
<td>There was significant positive correlation between the Colour Knowledge and Colourfulness of Design Portfolio. Thus, the more colour knowledge that architects had the more colourful were their design portfolios.</td>
<td></td>
</tr>
</tbody>
</table>

### Table 4.20: Summary of all analyses and results for testing influence of colour orientation, including colour preference and attitude towards colour, on architects’ colour choice and use

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>IV</th>
<th>DV</th>
<th>Method</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colour Orientation (Preference)</td>
<td></td>
<td>Colourfulness of Design Portfolio</td>
<td></td>
<td>Colour Orientation predicts the colourfulness of design portfolios. Neither predictor had significant partial effects in the full model.</td>
</tr>
<tr>
<td>Colour Orientation (Preference)</td>
<td></td>
<td>Specific Colourfulness of Designs (1 + 2)</td>
<td></td>
<td>Colour Orientation predicts the colourfulness of built designs. But only Architectural Colourfulness Preference can significantly predict Specific Colourfulness of Design (1+2) in the model.</td>
</tr>
<tr>
<td>Colour Orientation (Preference)</td>
<td></td>
<td>Favourite Colour</td>
<td></td>
<td>There is a significant association between Favourite Colours and Least Favourite Colours.</td>
</tr>
<tr>
<td>Gender</td>
<td>X</td>
<td>Least Favourite Colour</td>
<td></td>
<td>There is no association between Gender and Favourite colours. Moreover it shows that both gender were more interested to Cold colours as their favourite colours.</td>
</tr>
<tr>
<td>Culture (Country of childhood)</td>
<td>X</td>
<td>X</td>
<td>Chi-Square/ Crosstab</td>
<td>There is a significant association between Country of childhood and Least Favourite colours. Moreover, it shows that Iranian are more not interested in Grayscale than Australian. Also shows Australian are more not interested in Purple, Pink and yellow than Iranian. Moreover, it shows that both countries are more interested in Cold colours as their favourite colours than Warm and Neutral colours. However Cold and warm colours were most nominated by Australian as their least favourite colours.</td>
</tr>
<tr>
<td>Do any colours or hue tend to dominate?</td>
<td>Yes</td>
<td>62.9% Female, 59.8% Male</td>
<td></td>
<td>With 63.4% of participants said Yes and 38.6% of participants said that they don’t have any dominant colour or hue in their designs, it shows that most architects stick to use specific colours in all of their designs.</td>
</tr>
<tr>
<td>Gender &amp; dominant colour</td>
<td>Yes</td>
<td>59.8%</td>
<td>40.2%</td>
<td>The result shows that Female architects are more likely to use specific colours/ colour palette in their design (dominant colours in their designs) in comparison to Male architects</td>
</tr>
<tr>
<td>Any colour or hue tends to dominate?</td>
<td>IRAN</td>
<td>62.9%</td>
<td></td>
<td>Australia: Grey, Beige, Red, White</td>
</tr>
<tr>
<td></td>
<td>AUSTRALIA</td>
<td>59.8%</td>
<td></td>
<td>Iran: White, Red, Yellow, Grey</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Blue, Black: the same in both countries</td>
</tr>
</tbody>
</table>
### Chapter 4: Analysis and Results

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Sub-Hypothesis</th>
<th>Research Question</th>
<th>DV</th>
<th>Significant</th>
<th>Method</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>(H-6) Of the general factors that inform an architect's colour use (colour knowledge, culture, attitudes and preferences), architects will perceive that knowledge has the greatest impact.</td>
<td>(6.2) Rate the impact of each of the following factors on your use of colour in your design work in general?</td>
<td>Perceived Impact of <strong>Physical &amp; Cultural Context</strong> of design (Mean=4.12)</td>
<td>✔</td>
<td>1-sample T-Test</td>
<td>Perceived impact of Colour Knowledge, physical and cultural context is significantly more influential than the other factors.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Perceived Impact of <strong>Attitudes &amp; Preferences</strong> on colour use (Mean=3.93)</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Perceived Impact of <strong>Client Preference</strong> on design (Mean=3.92)</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Perceived Impact of <strong>Colour Knowledge</strong> on colour use (Mean=3.35)</td>
<td>✔</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Perceived Impact of <strong>Cultural Background</strong> on colour use (Mean=3.14)</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Neutral Point (3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(H-7) Architects will see that of the 3 general contexts for colour use (exteriors, interiors and landscape), colour will be of most importance to interiors.</td>
<td>(6.1) How do you rate the importance of colour in: (interiors, exteriors, landscape)</td>
<td>Importance of <strong>Exteriors Colour</strong> to architecture (Mean=3.31)</td>
<td>✔</td>
<td>1-sample T-Test</td>
<td>It means that Architects are agree or strongly agree that colour is an important consideration to building Exterior (i.e., facades).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Importance of <strong>Landscape Colour</strong> to architecture (Mean=3.19)</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Importance of <strong>Interiors Colour</strong> to architecture (Mean=3.16)</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Neutral Point (3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purpose of colour use</td>
<td>Q (6.3) Rate The importance of the following 4 functions of colour to your design process?</td>
<td>Not at all</td>
<td>Minimally important</td>
<td>Some what</td>
<td>Moderately important</td>
<td>Very important</td>
</tr>
<tr>
<td></td>
<td>As applied decoration</td>
<td>Mean= 3.61</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Integral to design concept</td>
<td>Mean= 3.59</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>To contrast or blend a design to its context</td>
<td>Mean= 4.17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>To encourage a psychological/emotional response</td>
<td>Mean= 4.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Excel (Percentage)</td>
<td>40% disagree/strongly disagree</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q (5.9) For all of my designs, I normally stick to a similar colour palette</td>
<td>Strongly disagree</td>
<td>Disagree</td>
<td>Neutral</td>
<td>Agree</td>
<td>Strongly agree</td>
<td>40% disagree/strongly disagree</td>
</tr>
</tbody>
</table>

#### Colour Orientation (Attitude)

<table>
<thead>
<tr>
<th>Purpose of colour use</th>
<th>Q (6.3) Rate The importance of the following 4 functions of colour to your design process?</th>
<th>Not at all</th>
<th>Minimally important</th>
<th>Some what</th>
<th>Moderately important</th>
<th>Very important</th>
</tr>
</thead>
<tbody>
<tr>
<td>As applied decoration</td>
<td>Mean= 3.61</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Integral to design concept</td>
<td>Mean= 3.59</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To contrast or blend a design to its context</td>
<td>Mean= 4.17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To encourage a psychological/emotional response</td>
<td>Mean= 4.16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excel (Percentage)</td>
<td>40% disagree/strongly disagree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Use of Colour as a Design Element

- Use of colour as an element used to encourage a psychological/emotional response and to contrast or blend a design to its content were very important to architects design process.
- The function of colour as an applied decoration and integral to design concept were known as moderately important to architect's design process.

#### Purpose of Colour Use

- Q (5.9) For all of my designs, I normally stick to a similar colour palette
  - Strongly disagree
  - Disagree
  - Neutral
  - Agree
  - Strongly agree
  - 40% disagree/strongly disagree
5.6 For each different design project, designers should try to use a strict colour palette that is informed by the specific urban context.

### Table 4.21: Summary of all analyses and results for testing influence of culture on architects’ colour choice and use

<table>
<thead>
<tr>
<th>Design 1 &amp; Design 2</th>
<th>Gender &amp; Design 1</th>
<th>Country &amp; Design 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design 1</td>
<td>Design 2</td>
<td>Male</td>
</tr>
<tr>
<td>Exemplars</td>
<td>Climate sensitive</td>
<td>Beautiful</td>
</tr>
<tr>
<td>Successful</td>
<td>Context sensitive</td>
<td>Client driven</td>
</tr>
<tr>
<td>Context sensitive</td>
<td>Minimal</td>
<td>Client driven</td>
</tr>
<tr>
<td>Minimal</td>
<td>Thoughtful</td>
<td>Client driven</td>
</tr>
<tr>
<td>Context sensitive</td>
<td>Thoughtful</td>
<td>Client driven</td>
</tr>
<tr>
<td>User</td>
<td>Avant-garde</td>
<td>Driven by personal taste</td>
</tr>
<tr>
<td>Driven by personal taste</td>
<td>User</td>
<td>Functional</td>
</tr>
<tr>
<td>Innovative</td>
<td>Minimal</td>
<td>22)</td>
</tr>
<tr>
<td>Cost effective</td>
<td>Context sensitive</td>
<td>Context effective</td>
</tr>
<tr>
<td>Conservative</td>
<td>Safe</td>
<td>Exemplars</td>
</tr>
<tr>
<td>Theoretical</td>
<td>Driven by personal taste</td>
<td>19)</td>
</tr>
<tr>
<td>Safe</td>
<td>Well trained</td>
<td>Mentor</td>
</tr>
<tr>
<td>Company signature</td>
<td>Well trained</td>
<td>Company signature</td>
</tr>
<tr>
<td>Well trained</td>
<td>Client driven</td>
<td>Adventurous</td>
</tr>
<tr>
<td>Adventurous</td>
<td>Cost effective</td>
<td>Fashion</td>
</tr>
<tr>
<td>Theoretical</td>
<td>13)</td>
<td>13)</td>
</tr>
<tr>
<td>Driven by personal taste</td>
<td>Avant-garde</td>
<td>Predictable</td>
</tr>
<tr>
<td>Predictable</td>
<td>Company signature</td>
<td>Consistent</td>
</tr>
<tr>
<td>Avant-garde</td>
<td>Exemplars</td>
<td>12)</td>
</tr>
<tr>
<td>Fashion</td>
<td>Climate sensitive</td>
<td>Well trained</td>
</tr>
<tr>
<td>Climate sensitive</td>
<td>Predictable</td>
<td>Fashion</td>
</tr>
<tr>
<td>Flamboyant</td>
<td>In the organizational style</td>
<td>Flamboyant</td>
</tr>
</tbody>
</table>

Table 4.21: Summary of all analyses and results for testing influence of culture on architects’ colour choice and use

### Hypothesis

- **H.3** Architects’ colour use will vary between designs

- **5.6** How would you describe the colour palette of your design (Project 1) (Please tick the relevant adjectives) (Colour use)

### Method

- Multiple regression & Chi-Square
- Multiple regression & Independent sample T-Test

### Result

- Culture (Country) cannot predict Architectural Colourfulness Preference.
- Culture (Country) can significantly predict Perceived Importance of Colour in Architecture with Primary Country of Design Education –Post graduate accounting for the greatest variance. The respondent from Iran chose lower score than Australian participants which means that the architectural Colourfulness Preference of Australian is much more influenced by Country of Practice, Country of Childhood and Country of Design Education undergraduate and Postgraduate. This is both economic and political.
**Chapter 4: Analysis and Results**

### Analysis and Results

**Hypothesis:**

1. Country of Practice (G)
2. Country of Childhood (G)
3. Country of Undergraduate Design Education (G)
4. Country of Postgraduate Design Education (G)

**Multiple regression & Independent sample T-Test**

Culture (Country) cannot significantly predict General Colourfulness Preference. There was no significant difference in scores for Australia and Iran for Architectural Colourfulness Preference.

**Hypothesis 2-2: Impact of Gender on Colour Attitudes Preference and Use**

<table>
<thead>
<tr>
<th>Gender</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Females had significantly higher scores than males</td>
</tr>
</tbody>
</table>

**Independent Sample T-Test**

Females had significantly higher scores than males for: Architectural Colourfulness Preference, perceived importance of colour to architecture, General Colourfulness Preference, and colourfulness of design portfolio, but there was no significant difference for colourfulness of (1 or 2) built designs.

**Hypothesis 2-3: Impact of Colour Culture on Colour Attitudes Preference and Use**

**Method**

- Nonparametric Correlation
- Independent Sample T-Test
- Chi Square

**Result**

The more culturally important colour was in the home-country the more important colour was to architecture.

**Themes**

- Socio-Cultural
- Contextual
- Socio-Cultural
- Contextual
- Socio-Cultural

**Colours in Visual Culture (Iran)**

- **Government**
  - Green (13)
  - Red (9)
  - Blue (10)
  - Black (11)
- **Environment**
  - Built environment
  - Built environment + Culture

**Bulleted List**

- Important and very important were received the most scores.
- There was no significant difference in scores for Australia and Iran for Architectural Colourfulness Preference.
### Chapter 4: Analysis and Results

#### Gender Vs Interior-Design 1

(H-2) The cultural background of an architect impacts their attitude to colour use when designing, their colour preference and colour use

<table>
<thead>
<tr>
<th>Themes</th>
<th>Socio-Cultural</th>
<th>Contextual</th>
<th>Culture</th>
<th>Context</th>
<th>Culture</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AUSTRALIA</strong></td>
<td>European Culture</td>
<td>World Cup Culture</td>
<td>Natural Heritage Context</td>
<td>Material</td>
<td>Built environment + Culture</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Navy Blue (3)</td>
<td>Neutral colour (4)</td>
<td>Avoid vivid colours (4)</td>
<td>Culture</td>
<td>Built environment + Culture</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Grey (15)</td>
<td>Natural colours (14)</td>
<td>Light/ Geography</td>
<td>Socio-Cultural Context</td>
<td>Natural environment</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Red (16)</td>
<td>Neutral colours (15)</td>
<td>White (12)</td>
<td>Built environment + Culture</td>
<td>Environment</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ochre/Brown (3)</td>
<td>Built environment</td>
<td>Natural</td>
<td></td>
<td>Environment</td>
</tr>
</tbody>
</table>

#### Hypothesis

<table>
<thead>
<tr>
<th></th>
<th>Female – Design 1 Interior</th>
<th>Male – Design 1 Interior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harmonious</td>
<td>2 3 4 5 6</td>
<td></td>
</tr>
<tr>
<td>Pleasant</td>
<td>2 3 4 5 6</td>
<td></td>
</tr>
<tr>
<td>Comfortable</td>
<td>2 3 4 5 6</td>
<td></td>
</tr>
<tr>
<td>Spacious</td>
<td>2 3 4 5 6</td>
<td></td>
</tr>
<tr>
<td>Static</td>
<td>2 3 4 5 6</td>
<td></td>
</tr>
<tr>
<td>Exciting</td>
<td>2 3 4 5 6</td>
<td></td>
</tr>
<tr>
<td>Introverted</td>
<td>2 3 4 5 6</td>
<td></td>
</tr>
</tbody>
</table>

#### There was no statistically significant change between male and female scores for Interior - Design 1.

### Gender Vs Interior-Design 2

<table>
<thead>
<tr>
<th></th>
<th>Female – Design 2 Interior</th>
<th>Male – Design 2 Interior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harmonious</td>
<td>2 3 4 5 6</td>
<td></td>
</tr>
<tr>
<td>Pleasant</td>
<td>2 3 4 5 6</td>
<td></td>
</tr>
</tbody>
</table>

#### There was no statistically significant change between male and female scores for Interior - Design 2.
<table>
<thead>
<tr>
<th>Culture</th>
<th>Female – Design 1 Exterior</th>
<th>Male – Design 1 Exterior</th>
<th>Female – Design 2 Exterior</th>
<th>Male – Design 2 Exterior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comfortable (1)</td>
<td>2.27</td>
<td>2.29</td>
<td>3.13</td>
<td>2.24</td>
</tr>
<tr>
<td>Spacious (1)</td>
<td>2.28</td>
<td>2.15</td>
<td>3.00</td>
<td>2.17</td>
</tr>
<tr>
<td>Dynamic (1)</td>
<td>3.07</td>
<td>3.32</td>
<td>3.91</td>
<td>3.36</td>
</tr>
<tr>
<td>Dynamic (1)</td>
<td>3.93</td>
<td>4.63</td>
<td>3.74</td>
<td></td>
</tr>
<tr>
<td>Dynamic (1)</td>
<td>4.14</td>
<td>4.14</td>
<td>3.74</td>
<td></td>
</tr>
</tbody>
</table>

There was statistically significant increase in *Exciting* Calming from Female to Male score for Exterior-Design 1.

There was statistically significant decrease in *Harmonious* Discordant and *Pleasant* Unpleasant from Female to Male score for Exterior-Design 2.
## Analysis and Results

<table>
<thead>
<tr>
<th>Country Vs Interior-Design 1</th>
<th>Iran – Design 1 Interior</th>
<th>Australia – Design 1 Interior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harmonious</td>
<td>2 3 4 5 6</td>
<td>Harmonious</td>
</tr>
<tr>
<td>Exciting</td>
<td>2 3 4 5 6</td>
<td>Exciting</td>
</tr>
<tr>
<td>Introverted</td>
<td>2 3 4 5 6</td>
<td>Introverted</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Country Vs Interior-Design 2</th>
<th>Iran – Design 2 Interior</th>
<th>Australia – Design 2 Interior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harmonious</td>
<td>2 3 4 5 6</td>
<td>Harmonious</td>
</tr>
<tr>
<td>Exciting</td>
<td>2 3 4 5 6</td>
<td>Exciting</td>
</tr>
<tr>
<td>Introverted</td>
<td>2 3 4 5 6</td>
<td>Introverted</td>
</tr>
</tbody>
</table>

**Static** (1) 3.03 3.12 ×

**Exciting** (1) 3.84 3.68 ×

**Introverted** (1) 4.38 4.59 ×

**Static** (7) 3.29 3.79 ×

**Exciting** (1) 4.69 4.42 ×

**Introverted** (1) 4.19 3.81 ×

<table>
<thead>
<tr>
<th>Country Vs Interior-Design 1</th>
<th>Iran – Design 1 Interior</th>
<th>Australia – Design 1 Interior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harmonious</td>
<td>2 3 4 5 6</td>
<td>Harmonious</td>
</tr>
<tr>
<td>Exciting</td>
<td>2 3 4 5 6</td>
<td>Exciting</td>
</tr>
<tr>
<td>Introverted</td>
<td>2 3 4 5 6</td>
<td>Introverted</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Country Vs Interior-Design 2</th>
<th>Iran – Design 2 Interior</th>
<th>Australia – Design 2 Interior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harmonious</td>
<td>2 3 4 5 6</td>
<td>Harmonious</td>
</tr>
<tr>
<td>Exciting</td>
<td>2 3 4 5 6</td>
<td>Exciting</td>
</tr>
<tr>
<td>Introverted</td>
<td>2 3 4 5 6</td>
<td>Introverted</td>
</tr>
</tbody>
</table>

**Static** (1) 2.92 2.65 ×

**Exciting** (1) 2.14 2.63 ×

**Introverted** (1) 2.76 2.92 ×

**Static** (7) 2.32 2.72 ×

**Exciting** (1) 4.69 4.42 ×

**Introverted** (1) 4.19 3.81 ×

<table>
<thead>
<tr>
<th>Country Vs Interior-Design 1</th>
<th>Iran – Design 1 Interior</th>
<th>Australia – Design 1 Interior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harmonious</td>
<td>2 3 4 5 6</td>
<td>Harmonious</td>
</tr>
<tr>
<td>Exciting</td>
<td>2 3 4 5 6</td>
<td>Exciting</td>
</tr>
<tr>
<td>Introverted</td>
<td>2 3 4 5 6</td>
<td>Introverted</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Country Vs Interior-Design 2</th>
<th>Iran – Design 2 Interior</th>
<th>Australia – Design 2 Interior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harmonious</td>
<td>2 3 4 5 6</td>
<td>Harmonious</td>
</tr>
<tr>
<td>Exciting</td>
<td>2 3 4 5 6</td>
<td>Exciting</td>
</tr>
<tr>
<td>Introverted</td>
<td>2 3 4 5 6</td>
<td>Introverted</td>
</tr>
</tbody>
</table>

**Static** (1) 2.32 2.72 ×

**Exciting** (1) 1.95 2.41 ×

**Introverted** (1) 2.53 2.53 ×

**Static** (7) 3.22 3.10 ×

There was statistically significant increase in “comfortable/uncomfortable” from Iran to Australia. Also, There was statistically significant decrease in “Spacious/confide” from Iran to Australia.

There was no statistically significant change between Iran and Australia scores for Interior - Design 2.
<table>
<thead>
<tr>
<th>Country Vs Exterior-Design 1</th>
<th>Country Vs Exterior-Design 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Iran – Design 1 Exterior</strong></td>
<td><strong>Iran – Design 2 Exterior</strong></td>
</tr>
<tr>
<td>Harmonious (I)</td>
<td>Harmonious (I)</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3.62</td>
<td>3.62</td>
</tr>
<tr>
<td>Pleasant (I)</td>
<td>Pleasant (I)</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4.35</td>
<td>4.35</td>
</tr>
<tr>
<td>Comfortable (I)</td>
<td>Comfortable (I)</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4.38</td>
<td>4.38</td>
</tr>
<tr>
<td>Spacious (I)</td>
<td>Spacious (I)</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2.14</td>
<td>2.14</td>
</tr>
<tr>
<td>Static (I)</td>
<td>Static (I)</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3.70</td>
<td>3.70</td>
</tr>
<tr>
<td>Exciting (I)</td>
<td>Exciting (I)</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4.39</td>
<td>4.39</td>
</tr>
<tr>
<td>Introverted (I)</td>
<td>Introverted (I)</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3.62</td>
<td>3.62</td>
</tr>
<tr>
<td><strong>Australia – Design 1 Exterior</strong></td>
<td><strong>Australia – Design 2 Exterior</strong></td>
</tr>
<tr>
<td>Harmonious (I)</td>
<td>Harmonious (I)</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3.70</td>
<td>3.70</td>
</tr>
<tr>
<td>Pleasant (I)</td>
<td>Pleasant (I)</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4.38</td>
<td>4.38</td>
</tr>
<tr>
<td>Comfortable (I)</td>
<td>Comfortable (I)</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4.39</td>
<td>4.39</td>
</tr>
<tr>
<td>Spacious (I)</td>
<td>Spacious (I)</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2.14</td>
<td>2.14</td>
</tr>
<tr>
<td>Static (I)</td>
<td>Static (I)</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3.70</td>
<td>3.70</td>
</tr>
<tr>
<td>Exciting (I)</td>
<td>Exciting (I)</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4.39</td>
<td>4.39</td>
</tr>
<tr>
<td>Introverted (I)</td>
<td>Introverted (I)</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3.62</td>
<td>3.62</td>
</tr>
</tbody>
</table>

There was statistically significant decrease in “Spacious/ Confined” from Iran to Australia score for Exterior-Design 1.

There was statistically significant decrease in “Spacious/ Confined” from Iran to Australia score for Exterior-Design 2.
Table 4.22: Summary of all analyses and results for testing influence of practice, including people and place/context, on architects' colour choice and use

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Sub-Hypothesis</th>
<th>DV (RQ: How would you rate the impact of following people and factors?)</th>
<th>Significant</th>
<th>Method</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived Influence on Colour Use (H-5-A)</td>
<td>(H-5-A-1) Difference in influence on colour use between Architects, Clients, LPA, Urban Designer, Colour Consultant, and Design Context</td>
<td>Architect (non-Parametric) (Mean= 4.30)</td>
<td>✓</td>
<td>1-sample T-Test &amp; Sample Wilcoxon Signed-Rank Test for non-parametric variables</td>
<td>It means that Perceived influence of Architects, Design Context, Client, UD, and LPA are Moderately or Highly influenced the colour of the built environment. It also means that the influence of Colour Consultant is Somewhat influenced the colour of the built environment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Client (Mean= 3.8)</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>LPA (Mean=3.41)</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Urban Designer (Mean=3.4)</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Colour Consultant (Mean= 3.1)</td>
<td>×</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actual Influence on Colour Use (H-5-B)</td>
<td>(H-5-B-1) Difference in influence on actual colour use between Architects, Clients, LPA, Urban Designer, Colour Consultant, and Design Context</td>
<td>Architectural team (non-Parametric) (Mean= 4.13)</td>
<td>✓</td>
<td>1-sample T-Test &amp; Sample Wilcoxon Signed-Rank Test for non-parametric variables</td>
<td>It means that Perceived influence of Client and Architects are Moderately or Highly influenced Architects' colour use. It also means that the influence of LPA and Interior Designer are not at all or Minimally influenced Architects' colour use.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Client (Mean= 3.6)</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Neutral Point (3)</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Interior Designer (Mean= 2.48)</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>LPA (Mean= 2.27)</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Survey Question:

8.2.1 Tell us about others that influence the colour of our environment?

<table>
<thead>
<tr>
<th>Survey Question</th>
<th>Perceived Influence on Colour Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Client User (2%)</td>
<td>Highest</td>
</tr>
<tr>
<td>Material importer/Supplier/Dealer (15%)</td>
<td>Highest</td>
</tr>
<tr>
<td>Artists/Painters (13%)</td>
<td>Highest</td>
</tr>
<tr>
<td>City/Planning authorities (6%)</td>
<td>Highest</td>
</tr>
<tr>
<td>Advertisers/marketers (6%)</td>
<td>Highest</td>
</tr>
<tr>
<td>Landscape designer (4%)</td>
<td>Highest</td>
</tr>
<tr>
<td>Education Curriculum (4%)</td>
<td>Highest</td>
</tr>
<tr>
<td>Media (Social media, TV contests) (4%)</td>
<td>Highest</td>
</tr>
<tr>
<td>Fashion Trend (4%)</td>
<td>Highest</td>
</tr>
<tr>
<td>Computer/Developer style (4%)</td>
<td>Highest</td>
</tr>
<tr>
<td>Government/religion (3%)</td>
<td>Highest</td>
</tr>
<tr>
<td>Design Journals (3%)</td>
<td>Highest</td>
</tr>
<tr>
<td>Lightning designer (3%)</td>
<td>Highest</td>
</tr>
<tr>
<td>Architects (1%)</td>
<td>Highest</td>
</tr>
<tr>
<td>Real estate agents (1%)</td>
<td>Highest</td>
</tr>
<tr>
<td>Digital sign designers (1%)</td>
<td>Highest</td>
</tr>
</tbody>
</table>
### H3-1. Comparison of Colourfulness between Designs according the Design-Context

<table>
<thead>
<tr>
<th>19 contextual factors (time 1) vs 19 contextual factors (time 2)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Typology (D-2)</td>
<td>Typology (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>Urban Density (D-2)</td>
<td>Urban Density (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>Natural features (D-2)</td>
<td>Natural features (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>Neighbouring Building (D-2)</td>
<td>Neighbouring Building (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>Prominent Building (D-2)</td>
<td>Prominent Building (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>Historical context (D-2)</td>
<td>Historical context (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>B. Orientation (D-2)</td>
<td>B. Orientation (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>B. Height (D-2)</td>
<td>B. Height (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>Climate (D-2)</td>
<td>Climate (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>Light (D-2)</td>
<td>Light (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>Urban Planning Restriction (D-2)</td>
<td>Urban Planning Restriction (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>Cultural context (D-2)</td>
<td>Cultural context (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>Night (D-2)</td>
<td>Night (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>Psychological Impact (D-2)</td>
<td>Psychological Impact (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>Stand/Blend (D-2)</td>
<td>Stand/Blend (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>Safety Coding (D-2)</td>
<td>Safety Coding (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>Space Perception (D-2)</td>
<td>Space Perception (D-2)</td>
<td>✓</td>
</tr>
<tr>
<td>Way finding (D-2)</td>
<td>Way finding (D-2)</td>
<td>×</td>
</tr>
</tbody>
</table>

There was no statistically significant change in Colourfulness from Design 1 (M = 3.71, SD = 1.38) to Design 2 (M = 3.52, SD = 1.29), t(20) = 0.640. The mean decrease in Colourfulness was 0.19.

### H3-2. Difference between Impacts of Design Context Factors from Design to Design 2

<table>
<thead>
<tr>
<th>19 contextual factors (time 1) vs 19 contextual factors (time 2)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Typology (D-2)</td>
<td>Typology (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>Urban Density (D-2)</td>
<td>Urban Density (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>Natural features (D-2)</td>
<td>Natural features (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>Neighbouring Building (D-2)</td>
<td>Neighbouring Building (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>Prominent Building (D-2)</td>
<td>Prominent Building (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>Historical context (D-2)</td>
<td>Historical context (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>B. Orientation (D-2)</td>
<td>B. Orientation (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>B. Height (D-2)</td>
<td>B. Height (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>Climate (D-2)</td>
<td>Climate (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>Light (D-2)</td>
<td>Light (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>Urban Planning Restriction (D-2)</td>
<td>Urban Planning Restriction (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>Cultural context (D-2)</td>
<td>Cultural context (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>Night (D-2)</td>
<td>Night (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>Psychological Impact (D-2)</td>
<td>Psychological Impact (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>Stand/Blend (D-2)</td>
<td>Stand/Blend (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>Safety Coding (D-2)</td>
<td>Safety Coding (D-2)</td>
<td>×</td>
</tr>
<tr>
<td>Space Perception (D-2)</td>
<td>Space Perception (D-2)</td>
<td>✓</td>
</tr>
<tr>
<td>Way finding (D-2)</td>
<td>Way finding (D-2)</td>
<td>×</td>
</tr>
</tbody>
</table>

There was a statistically significant decrease in "Perception of Space" scores from Design 1 to 2. It means that the use of colour for each design is different based on the perception of space in each specific design.

### H-5-B Of the multiple influences on an architect's actual colour use (Architects, Clients, LPA, Urban Designer, Colour Consultant, and Design Context), only the Architect, client and the designs context will have been significant.

<table>
<thead>
<tr>
<th>Concept</th>
<th>Similar examples</th>
<th>Restriction rules</th>
<th>Formal architectural style</th>
<th>Safe/ Ease palette</th>
<th>Budget</th>
<th>Company style</th>
<th>Psychological influence</th>
<th>Personal Preference</th>
<th>Bold/ attractive</th>
<th>Function</th>
<th>Material</th>
<th>Client Preference</th>
<th>Context</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
<td>2%</td>
<td>3%</td>
<td>3%</td>
<td>4%</td>
<td>5%</td>
<td>7%</td>
<td>10%</td>
<td>19%</td>
<td>17%</td>
</tr>
</tbody>
</table>
## Chapter 4: Analysis and Results

(H-3-2) Difference between Impacts of Design Context
Factors from Design to Design 2

### Significant

<table>
<thead>
<tr>
<th>Design 1 (19 Variables)</th>
<th>Design 2 (19 Variables)</th>
<th>Significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typology (Mean= 3.73)</td>
<td>Typology (Mean= 3.60)</td>
<td>✓</td>
</tr>
<tr>
<td>Space Perception (Mean= 3.73)</td>
<td>Stand/Blend (Mean= 3.67)</td>
<td>✓</td>
</tr>
<tr>
<td>Stand/Blend (Mean= 3.68)</td>
<td>Space Perception (Mean= 3.62)</td>
<td>✓</td>
</tr>
<tr>
<td>Psychological Impact (Mean= 3.48)</td>
<td>Psychological Impact (Mean= 3.44)</td>
<td>✓</td>
</tr>
<tr>
<td>B. Form (Mean= 3.36)</td>
<td>B. Form (Mean= 3.29)</td>
<td>X</td>
</tr>
<tr>
<td>Natural features (Mean= 3.36)</td>
<td>Natural features (Mean= 3.13)</td>
<td>X</td>
</tr>
<tr>
<td>Climate (Mean= 3.16)</td>
<td>Historical context (Mean= 3.07)</td>
<td>X</td>
</tr>
<tr>
<td>Light (Mean= 3.12)</td>
<td>Urban Density (Mean= 3.06)</td>
<td>X</td>
</tr>
<tr>
<td>Night (Mean= 3.02)</td>
<td>Night (Mean= 3.00)</td>
<td>X</td>
</tr>
</tbody>
</table>

### One Sample T-Test

DESIGN 1
It means that Typology, Space Perception, Stand or Blend, Natural Features, and Building Form are moderately or highly influenced the colour choice of Design 1. It also means that Neighbouring Building, Urban Planning Restriction, Prominent Building and Safety Coding were not at all or minimally considered in the colour choice of Design 1.

DESIGN 2
It means that Typology, Stand or Blend, Space Perception, and Psychological impact are moderately or highly influenced the colour choice of Design 2. It also means that Urban Planning Restriction, Cultural Context, Prominent Building, and Safety Coding are not at all or minimally considered in the colour choice of Design 2.

### Architects’ colour uses will vary between designs.

(H-3-1) Architects’ colour uses will vary between designs according to the relative importance of the designs context

### Actual colour use (Design 1 & 2)

<table>
<thead>
<tr>
<th>Categories</th>
<th>Design 1 (19 Variables)</th>
<th>Design 2 (19 Variables)</th>
<th>Visibility + Physical/Cultural Context</th>
<th>Factor Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar Access</td>
<td>B. Orientation</td>
<td>Light</td>
<td>Safety Coding</td>
<td></td>
</tr>
<tr>
<td>Urban Context</td>
<td>Neighbouring Building</td>
<td>Cultural Context</td>
<td>Way Finding</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prominent Building</td>
<td>Space Perception</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Natural features</td>
<td>Natural features</td>
<td>B. Form</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Urban Density</td>
<td>B. Height</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Psychological Impact</td>
<td>B. Orientation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Night</td>
<td>Neighbouring Building</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Way Finding</td>
<td>Prominent Building</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Space Perception</td>
<td>Historical context</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cultural context</td>
<td>Night</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Typology</td>
<td>Psychological Impact</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Urban Planning Restriction</td>
<td>Stand/Blend</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
There was statistically significant decrease in "Harmonious/ Discordant" and "Introverted/Extroverted" from Interior to Exterior in Design 1.

The result shows no statistically significant change in colour use from Interior to Exterior in Design 2.

(H-3) Architects' colour uses will vary between designs.
### Paired-Sample T-Test

There was statistically significant decrease in decrease in interior “Exciting/Calming” scores from Design 1 to Design 2.
### Chapter 4: Analysis and Results

#### Paired-Sample T-Test

There was statistically significant increase in Exterior "Harmonious/ Discordant" scores from Design 1 to Design 2. There was a statistically significant increase in Exterior "Pleasant/Unpleasant" scores from Design 1 to Design 2.

<table>
<thead>
<tr>
<th></th>
<th>Design 1 – Exterior</th>
<th>Design 2 – Exterior</th>
<th>Paired-Sample T-Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harmonious (1)</td>
<td><img src="2.15" alt="2.15" /></td>
<td><img src="2.50" alt="2.50" /></td>
<td></td>
</tr>
<tr>
<td>Discordant (7)</td>
<td><img src="2.29" alt="2.29" /></td>
<td><img src="1.53" alt="1.53" /></td>
<td></td>
</tr>
<tr>
<td>Pleasant (1)</td>
<td><img src="2.19" alt="2.19" /></td>
<td><img src="2.53" alt="2.53" /></td>
<td></td>
</tr>
<tr>
<td>Unpleasant (7)</td>
<td><img src="2.20" alt="2.20" /></td>
<td><img src="1.55" alt="1.55" /></td>
<td></td>
</tr>
<tr>
<td>Comfortable (1)</td>
<td><img src="2.17" alt="2.17" /></td>
<td><img src="2.39" alt="2.39" /></td>
<td></td>
</tr>
<tr>
<td>Confined (7)</td>
<td><img src="2.38" alt="2.38" /></td>
<td><img src="3.06" alt="3.06" /></td>
<td></td>
</tr>
<tr>
<td>Dynamic (1)</td>
<td><img src="3.58" alt="3.58" /></td>
<td><img src="3.76" alt="3.76" /></td>
<td></td>
</tr>
<tr>
<td>Static (7)</td>
<td><img src="3.58" alt="3.58" /></td>
<td><img src="4.35" alt="4.35" /></td>
<td></td>
</tr>
<tr>
<td>Calming (1)</td>
<td><img src="3.77" alt="3.77" /></td>
<td><img src="4.40" alt="4.40" /></td>
<td></td>
</tr>
<tr>
<td>Calming (7)</td>
<td><img src="3.77" alt="3.77" /></td>
<td><img src="4.40" alt="4.40" /></td>
<td></td>
</tr>
<tr>
<td>Exciting (1)</td>
<td><img src="4.35" alt="4.35" /></td>
<td><img src="4.48" alt="4.48" /></td>
<td></td>
</tr>
<tr>
<td>Calming (7)</td>
<td><img src="4.35" alt="4.35" /></td>
<td><img src="4.48" alt="4.48" /></td>
<td></td>
</tr>
</tbody>
</table>

Note: The table shows the mean scores for each attribute, with Design 1 on the left and Design 2 on the right. The paired-sample t-test results indicate significant differences in the specified attributes.
CHAPTER 5: DISCUSSION
CHAPTER 5 – DISCUSSION

5.1 INTRODUCTION TO DISCUSSION

This chapter is composed of seven sections. The introduction is followed by five sections (Sections 5.2 to 5.6), each interpreting and discussing the findings in line with their relation to the hypotheses of the thesis, and critically examining these findings in the light of previous research. The first four sections are: (1) impact on colour use of colour education (Section 5.2); (2) impact on colour use of knowledge (Section 5.3); (3) impact on colour use of colour culture (Section 5.4); and (4) impact on colour use of practice influences (people/professionals and context) (Section 5.5). For each of these first four sections, the discussion of colour use covers two aspects: colourfulness and colour (hue) choice. The results section also posits a new influence on colour use – colour orientation – that combines colour attitude and colour preference. Thus, Section 5.6 discusses the relationships between colour orientation and colourfulness and hue choice. The chapter concludes by summarising and synthesising the findings and their implications into an overall understanding of what informs architects’ colour use (Section 5.7). This final section suggests that colour use in architecture has two chief influences: (1) colourfulness orientation (architects’ attitudes and prejudices towards colour use, which vary little if at all between designs); and (2) contextual variables (specific to each design, but which might have a greater role in informing colour choices than the colourfulness of designs).

5.2 IMPACT ON COLOUR UNDERSTANDING OF COLOUR EDUCATION

This thesis hypothesises that the design education of an architect predicts their colour understanding and their attitude to colour use when designing, but not their colourfulness preference or actual colour use (H.1). Two key but perhaps predictable findings from seven individual multiple regression analyses are that the levels of
colour education that architects received significantly predict: (1) their colour knowledge (Section 4.2), which in turn is significantly predicted specifically by colour theory education (but not colour practice education i.e. not through using colour when designing during design education); and (2) how much they perceived their design education had informed their colour knowledge (Section 4.2). Levels of colour education also significantly predict how important to architectural design architects perceived that colour is. This latter finding is an important one for educators, for it could be said to imply that architects are more considered in their use of colour when better educated about colour. While the link between education and colour knowledge is strong, levels of colour education have little impact on architects’ general attitudes to how colourful buildings should be or, consistent with this finding, how colourful architects’ portfolios were or how colourful two of their most recent designs were.

Investigation of the place of colour training in architectural schools by analysing answers to the question: in your university or college education and training, was the study of colour part of your design course or curriculum? also reveals that none of the participants had studied a course specifically on colour use or theory, but had merely received basic information about colour theory as a part of another course with a different focus, such as communication and architectural studios. Thus, knowledge of colour, according to the qualitative comments, is described as most commonly learned through the process of designing or as an aspect of the design process. However, the quantitative data shows that colour knowledge is significantly predicted by colour theory education (not colour practice education). Thus, while colour knowledge is most effectively learned via theory education, this is not how it is most commonly taught.
These findings of limited effective colour education are very much in line with those of Janssens and Mikellides (1998), who conclude that while architecture undergraduates perceived and evaluated colour as one of the most important concerns in their professional careers, they received little teaching on the subject. Similarly, while this thesis has found a clear recognition among practising architects, academics and postgraduates of the central role of colour to designing in practice, this recognition contrasts sharply with a severe lack of taught colour knowledge.

As found in Minah’s (1996) historical review of architects’ attitudes towards colour use, this study has recognised the lack of colour knowledge and difficulties of bringing colour theory into practice as important factors that hamper architects’ colour use (Section 2.5.1.1). While a review of architectural curricula completed as part of this thesis has revealed that Itten’s colour wheel is the main reference book in Iranian architectural schools, it seems Australian universities are not following any specific theory or method for their colour training. Practising colour wheels with watercolours is a common colour training method in both countries.

In summary, it is found that the colour theory education of an architect predicts their colour knowledge and also predicts the importance they attach to colour use when designing. Thus, it follows that architects better educated about colour may be more considered about the role of colour when designing. The relationship between colour knowledge and actual colour use is considered further in the following section.

5.3 IMPACT ON COLOUR USE OF COLOUR KNOWLEDGE

This thesis hypothesises that the colourfulness of architects’ designs increases as architects’ colour knowledge increases (H.4). Thus, it was expected that architects would be freer in their use of colour when they had higher levels of colour
knowledge. It is found using a Spearman rank-order correlation analysis, which measures the strength and direction of the relationships between variables, that there is indeed a significant correlation between colour knowledge and how colourful architects perceived their design portfolios were (Section 4.3). Strong correlation is also found between the colourfulness of architects’ design portfolios and the colourfulness of two of their designs. Thus, the colourfulness of architects’ designs across their careers is consistent with the colourfulness of two case-study designs. This suggests colourfulness preference is long term and varies little between buildings and contexts, meaning it is a highly personal and subjective predilection of an architect.

In addition, results show that the more colour knowledge architects had, the more colourful they perceived their design portfolios were. In other words, it can be suggested that the level of an architect’s colour knowledge has an impact on the colourfulness of their designs. Thus, it might be interpreted that a lack of knowledge leads to a reluctance to use colour, perhaps because of a fear of using it inappropriately. This finding is an important one for educationalists and also for society in general, for it may imply by extension that architects’ lack of colour knowledge may influence not only the colourfulness of their designs, but also their actual colour (hue) choice. Thus, it can be suggested that lack of colour knowledge affects colour use in the built environment, which in turn can influence people’s quality of life and wellbeing via ill-considered colour use. Therefore, in line with Minah’s (2013) suggestion about the altruistic use of colour (Section 2.5), it can be argued that in order to be able to colour interior and exterior spaces in ways that alleviate stress and increase comfort, adding colour knowledge and understanding to the standard architecture curriculum is an important step towards this goal.
5.4 IMPACT ON COLOUR USE OF COLOUR CULTURE

This thesis hypothesises that the cultural background of an architect affects their attitude to colour use when designing, their colour preference and colour use (H-2). The hypothesis relates the impact of cultural background to three aspects of architects’ colour use: colour orientation (attitude and preferences to colour use in general), colourfulness and colour (hue) choice.

5.4.1 CULTURE AND COLOUR ORIENTATION

One finding from the multiple regressions investigating the predictive power of cultural background is that the country of postgraduate education significantly predicts how important architects perceived that colour is to design (Section 4.4). This finding has been determined via two methods: (1) by comparing scores for Australian and Iranian architects for the question How important do you think the use of colour is in architecture?; and (2) by answering the question Do Iranian or Australian architects see colour as more important to design? via running a chi-square and crosstab analysis. Although the results of the chi-square analysis show no significant difference between culture and importance of colour to architects, the result of the crosstab analysis reveals that architects who completed their postgraduate education in Australia found colour to be significantly more important to design (60.2%) than Iranian architects (39.8%). Therefore, it can be argued that the primary country of postgraduate education influences architects’ colour attitude.

This finding can be said to suggest that architects become more open to cultural influences the more sophisticated their understanding of design becomes i.e. later on in their design education. Thus, once architects begin to master the process of designing, they may become more open to incorporating qualities of design, such as colour, that are more nuanced and perhaps not seen as fundamental – even secondary. But we might ask, when compared to Iranian architects, why do...
architects who studied in Australia as postgraduates attach greater design importance to colour? One possible reason for this is that Australian architects have greater colour knowledge due to their postgraduate design education and that this knowledge informs greater attention to the use of colour. Indeed, a chi-square analysis (Section 4.4) shows that Australian architects had greater colour knowledge than Iranian architects and that the difference is significant. Thus, it can be said that differences in colour knowledge between Iran and Australia partly explain differences between the countries in the importance architects attach to colour.

Hypothesis H-2 considers the cultural influence of gender on colour orientation. According to H-2, it is hypothesised that architects’ colour attitude, preference and use are influenced by their gender. It has been found using independent-sample t-tests comparing the scores of each gender (Section 4.4) that female architects have significantly higher scores for colourfulness attitude, perceived importance of colour to architecture and colourfulness preference. It might also have been expected that female architects would have more colourful design portfolios. However, on the contrary, it has been found that male architects have significantly more colourful design portfolios. It can be argued therefore that because female architects attach more importance to colour use in their designs, they are more cautious in comparison to male architects in their use of colour.

A further key finding in relation to colour orientation and gender is that the gender of architects influenced their attitudes towards colour for exteriors, as female architects preferred to use colours externally to create more exciting, vibrant and pleasant spaces in comparison to male architects. Thus, although women may use fewer colours in their designs, they may be more willing to choose colours that make their buildings stand out from the surrounding environment.
5.4.2 CULTURE AND COLOUR CHOICE

Grounded theory has aided in investigating the relationship between culture and hue choice by analysing answers to the question: Tell us about any colour biases in the visual culture of your home country and how this is reflected (if at all) in the built environment? It has been found that colour biases in both countries are rooted in two main categories: (1) contextual factors; and (2) socio-cultural factors (Section 4.4). Although climatic conditions, light intensity, heritage context and local materials were referred to in comments from architects in both countries as contextual factors that may lead to preferences for certain colours, a large difference has been found between Iran and Australia in the impact of socio-cultural factors on colour choices. Iranian architects’ colour biases were mostly rooted in their religious, cultural beliefs and social norms, while socio-cultural factors in Australia referred to the conservative (i.e. restrained, reserved, traditionalist) nature of visual expression in the country, the influence of sports and national patriotism. The colour palette of Indigenous Australia and the influence of Western/European culture were also nominated as influential socio-cultural factors on colour use in Australia. Thus, while in Iranian architecture turquoise, green, azure blue and the colour of soil (reddish brown and ochre) were cited as the most commonly used colours, in Australian the architectural colour bias leaned towards the use of white, grey, natural colours and earth-based colours; in other words, the natural colours of building materials. However, it was also suggested that the use of green, red and yellow has a special place in contemporary architecture in Australia.

Iranian architects described the colours they use for both the interior and exterior of buildings as comfortable and from a confined palette, while Australians described their colour palettes for building exteriors as calming. A number of cultural influences might explain these differences. In contrast to the rich history of
an extensive use of architectural colour in Iran before the revolution, the eight years of war with Iraq resulted in a new revolutionary ideology that regards individual expression as frivolous, and thus colour has been obliterated from Iranian everyday life. This ideology, most clearly expressed in murals memorialising revolutionary heroes and martyrs of the war, has resulted in the domination of dark shades of grey, brown, navy blue and black in public space and especially in women’s clothing. These potent cultural and religious constraints against using bold and vivid colours might explain Iranian architects’ preferences for a limited range of colours in their designs. On the other hand, (as seen in particular in the comments of Iranian postgraduates) as new generations of Iranians are exposed to the West and the world of fashion, so the influence of Western visual culture is also beginning to inspire the use of more vivid colours in a new generation of Iranian architecture – helped by the importation of colourful new materials.

5.4.3 CULTURE AND COLOURFULNESS

It has been found that the importance architects attached to colour in their home culture (cultural potency of colour) has a significant correlation with: (1) the importance they attached to colour use in their designs; (2) the colourfulness of two of their designs; and (3) the colourfulness of their design portfolios (Figure 5.1).

![Figure 5.1: Correlation between cultural background and colour preference and attitude](image-url)
A series of multiple regressions and independent-sample t-tests were conducted to answer the further questions: Which country’s architects have more colourful designs and prefer more colourful buildings? and which of the four periods of cultural indoctrination have the greatest influence in relation to these colourfulness orientations? Multiple regressions suggest that the country in which architects spent four periods of cultural influence (country of practice, childhood, undergraduate and postgraduate design education) did not significantly affect their colourfulness preference, their general preference for how colourful buildings should be or, consistent with this finding, how colourful their portfolios were or how colourful two of their most recent designs were.

However, the findings of independent-sample t-tests reveal that architects practising in Australia (M=7.6, SD=2.34) not only claimed to a have greater tendency to use colour for the interiors and exteriors of their buildings in comparison to those practising in Iran (M=6.97, SD=2.05), but those who spent three periods of cultural influence (country of practice, childhood, undergraduate design education) in Australia (M=4.3, SD=1.4) had more colourful portfolios than Iranian architects (M=3.45, SD=1.2). However, it has also been found that the primary country of postgraduate education had no impact on the level of colourfulness of architects’ design portfolios.

To sum up, five prime cultural influences have been found when comparing the data from Iranian and Australian architects for the three spheres of colour use: colour orientation, colourfulness and colour (hue) choice. First, it is found that those who completed their postgraduate education in Australia attached greater importance to colour use in their designs. Thus, architects may become more open to cultural influences the more sophisticated their understanding of design becomes.
Second, it is found that architects practising in Australia had a greater tendency to use colour in exteriors and interiors and, moreover, Australian architects had more colourful portfolios. Third, it is found that colour (hue) bias differences in Iran and Australia are rooted in two main categories: (1) contextual factors; and (2) socio-cultural factors. But while Iranian colour biases were mostly influenced by religiocultural beliefs and social norms, Australians were more influenced by the conservative nature they perceive of their country and perhaps by the influence of national patriotism. Fifth, it is found that gender influenced architects’ colour orientation, colourfulness preference and colour (hue) choice and use. Therefore, it can be concluded that architects’ colour orientation, the colourfulness of their designs and their colour (hue) choice are influenced by their personal preferences, which have been formed during their childhood, design education and period of practising as an architect. However, having more colour knowledge and understanding can help architects to be more open to cultural influences.

5.5 IMPACT ON COLOUR USE OF PRACTICE

The following discussion of the influence of practice on architects’ colour use is divided into two main themes: (1) people/professionals; and (2) context.

5.5.1 PEOPLE/PROFESSIONALS

This study differentiates between the opinions of architects about what factors influence colour use in built environment practice generally and what factors influence their own colour use when designing. The differentiation aims to distinguish between external and internal (personal) influences on architects’ colour use. Thus, the thesis hypothesises that of the multiple influences on the use of colour generally in the built environment (architects, clients, LPAs, urban designers, colour consultants and design contexts), architects perceive only the clients and the design contexts as significant (H-5-A). Although the results of a one-sample t-test confirm
Chapter 5: Discussion

The hypothesis, it is found that, of the people involved in the design process, only architects themselves highly influenced the colour of the built environment, followed by the physical and cultural context of the design and then the client (Section 4.5.1). The thesis also hypothesises that, of the multiple influences on an architect’s own colour use when designing (architects, clients, LPAs, interior designers and design context), only architects, clients and the design contexts are significant. The results reveal that architects had the most influence on architects’ actual colour use when designing, followed by the physical and cultural contexts of design and then the clients. Interior designers and LPAs had little influence.

Grounded theory has aided in investigating practice influences further by analysing answers to the question: Tell us about others who influence the colour of our environment? The most frequent comments suggested clients/users, material importers, dealers and suppliers, and also artists/painters as significant other influential factors on colour use (Section 4.5.1, Figure 4.13). Moreover, in the contemporary world, it was suggested that forums such as social media, TV and design journals not only influenced architects’ colour choices, but also resulted in the creation of new fashion trends and changing of public colour tastes. In addition, the taste and preference of real estate agents about which colour palettes can increase the price of houses was suggested to influence the use of colour in contemporary cities, especially in residential neighbourhoods.

In summary, it can be seen that architects did not differentiate between colour use in the built environment generally or their own personal colour use in practice. In other words, the architect’s voice is, in the opinion of architects, the one of greatest influence both generally and specifically. The hierarchy of practice influences revealed across multiple analyses, which consistently identifies the
architect as the most potent opinion when it comes to colour use in the built environment, reinforces this finding.

5.5.2 CONTEXT

This thesis hypothesises that architects’ colour uses vary between designs to respond to the context of each design (H-3). A paired-sample t-test comparing the colourfulness of two designs reveals no significant change between designs, which suggests that context has little impact on the colourfulness of designs. However, further analysis suggests that the influence of context is not entirely neutral but is perhaps more nuanced, for it is found when evaluating the differences between the impacts of 19 design context factors from Design-1 to Design-2 that the hierarchy of context influences is quite dissimilar.

Comparison of the influence of the 19 contextual factors (Section 4.5.2, Table 4.15) reveals that design typology, perception of space, the relative importance of standing out or blending in and the psychological impact of colour highly to moderately influenced architects’ colour selections for their designs. However, the colour of neighbouring buildings, urban design and planning restrictions, the colour of prominent buildings that are visible from the site and safety coding had little influence on colour use.

A factor analysis reduced the 19 contextual factors of designs into a smaller number of factor sets (Section 4.5.2). This reveals that, despite similarities between the most and least important factors across both case-study designs, for each design the influential factors are categorised differently. While two sets of variables are common in both designs – urban context and prominence – the other contextual factors are different; in Design-1 these consist of solar access, perception and legislative restriction; while in Design-2 they are visibility–physical/cultural context, morphology and relationship with neighbouring buildings.
The finding that colour use is different between contexts is particularly due to how colour affects spatial perception is reinforced by how architects used adjectives to describe how their colours were perceived in interior and exterior spaces. For when comparing the two designs, it is found that the design intent of colour use differs between the two designs and between the interiors and exteriors of Design-1. However, the difference between interiors and exteriors is subtle, for most architects described their interior colour palette for Design-1 as harmonious and calming, and their exterior colour palette as harmonious and pleasant. It can be concluded that design intent reflecting colour and its impact on spatial perception is quite consistent between the inside and outside of a design, but differs notably between designs.

This finding, that context did indeed influence architects’ actual colour use in their designs, is reinforced by grounded theory analysis of the question: explain the reasons for and influential factors on your colour use for these designs. Here, context was most commonly identified, followed by client preference, materiality and function of the building. However, design concept and form, precedent, and restriction rules/regulations had little influence.

To sum up, it has been found that context did not influence the colourfulness of buildings. Instead, colourfulness was largely consistent across an architect’s portfolio and appears most influenced by the architect’s own preferences. However, it has been found that the choice of colours (hue), and design intent reflecting how colour influences the perception of space, are different between designs and thus must reflect context. It has also been found that the context factors that informed colour choice are quite different from one design to the next.
5.6 IMPACT ON COLOUR USE OF COLOUR ORIENTATION

As stated in Section 2.3.3.2, there is a strong correlation between personal colourfulness preferences and colourfulness attitudes. Thus these two variables can be conceptually combined into a new influence on colour use that this thesis terms colour orientation. The following discussion addresses the relationship between colour orientation, the colourfulness of designs and colour (hue) choice.

5.6.1 COLOUR PREFERENCE

It has been found from a multiple linear regression used to develop a model for predicting colourfulness of design portfolio and specific colourfulness of designs that the general preferences that architects expressed for how colourful they felt building interiors and exteriors should be (an aspect of colour orientation) significantly predicts how colourful their designs portfolios are. Moreover, the colourful of two of their recent designs is significantly predicted by architectural colourfulness preference.

Thus, an architect’s colourfulness orientation clearly influences how colourful their buildings are. In another words, the opinions and preferences, or what might even be called prejudices, an architect brings to projects about how colourful buildings should be all inform how colourful their own designs are irrespective of the contexts of their designs. This finding is reinforced by the significant correlation between the colourfulness of the architects’ design portfolios and the colourfulness of two of their most recent designs, as the colourfulness of specific designs is consistent with the colourfulness of architects’ designs over their careers.

To elucidate the impact of architects’ gender and culture (country of childhood) on their colour prejudices, they were asked to nominate their favourite and least favourite colours. A significant association has been found between favourite and least favourite colours using a chi-square and crosstab analysis. More
specifically, there is a significant association between an architect’s gender and their least favourite colours. Interestingly, both genders preferred cold colours as their favourites and warm colours as their least favourites. The comparison between favourite and least favourite colours in Iran and Australia reveals a significant difference only in least favourite colours. Similar to gender colour preference, it has also been found that both Iranian and Australian architects were more interested in cold colours as their favourite colours and claimed warm colours as their least favourite colours.

Grounded theory aided in investigating this finding further by analysing answers to the question: do any colours or hues tend to dominate in your designs? While more than half of the participants claimed that one colour is dominant in their designs, the results show that female architects were more likely to have dominant colours than male architects. The comparison between countries indicates that dominant colours for Iranian architects were bright and vivid, such as white, red and yellow, while Australian architects more commonly used natural colours, such as grey, beige and white.

These findings about colour biases might imply a contradiction between the place of vivid and bright colours in the socio-religious visual culture of Iran and the colours that dominate Iranian architects’ designs. Analysis of the question on colour bias in Iranian visual culture suggests that use of vivid and bright colours is considered inappropriate, for such colours are perceived as too bold and out of the norm, especially in the contexts of some ethnic groups and in relation to religious constraints limiting colour in women’s dress. But, seemingly in defiance of such cultural norms, the dominant colours of Iranian architects are described as vivid and bold. It might be suggested that, in common with other forms of artistic expression
in Iran, architects are, in their use of colour, pushing against the strict religious constraints of their culture.

In contrast, colour bias investigation in Australia has not suggested any rules or beliefs about the use of specific colours informed by socio-religious norms. Instead, it has been found that Australian architects’ predilection for natural colours such as grey and beige might be rooted in the conservative nature of Australians, a preference for using materials in their natural form and also reticence to use colour externally throughout much of the history of Western culture. Blue, black and green are colours that had a similar midway position of dominance in both countries i.e. neither dominant nor uncommon, suggesting a degree of comfort in using colours commonly found in nature. To sum up, it can be argued that architects’ colour (hue) preferences certainly appear influenced by culture, but in some cases this influence may inform use in designs that push the boundaries of cultural norms.

It should be noted that there is a common association that identifies architects who design colourful buildings with architects who use a dominant colour, although there may be a misunderstanding here between colourful as many-coloured and colourful as not black, grey or white. If the association between colourfulness and the use of dominant colour holds true, analysis might be expected to reveal that those who had more colourful design portfolios also had a dominant colour in their designs. However, the result of an independent-sample t-test comparing the colourfulness of the design portfolios of participants who had a dominant colour to those who did not reveals no significant relationship. However, this is likely due to a low response rate in the survey to the question about dominating colours when designing, and repeating this analysis with a larger sample could reveal a different result.
5.6.2 COLOUR ATTITUDE

This thesis hypothesises that of the general factors that inform an architect’s colour use (colour knowledge, culture, attitude and preference, and context), architects perceive that knowledge has the greatest impact (H-6). To test this, a one-sample t-test and a one-sample Wilcoxon signed-rank test (for non-parametric variables) were conducted to determine whether the scores of the five general factors influencing colour use are significantly different from the neutral point score (Section 4.4.1.2). Here, all four general factors (physical/cultural context of design, colour orientation, client preference and colour knowledge) were perceived as very to moderately important influences on colour use. But it has been found that the perceived impact of cultural background only somewhat influenced architects’ colour use. Thus, it can be seen that the results contradict the hypothesis, as it is found that the physical and cultural context of a design were perceived to have the greatest impact on architects’ colour use, respectively followed by perceived impact of attitude and preference, client preference and finally colour knowledge and culture. In contrast to the general expectation, it can be concluded that architects perceive that colour knowledge and cultural background have smaller impacts on their colour use than context and personal colour orientation (colourfulness preference and attitude).

Further attitudinal findings on the function of colour show that architects felt the use of colour to contrast or blend a design to its context, and the use of colour to encourage a psychological/emotional response, are both very important considerations when designing. Again, the potency of colour in relation to these functions might be seen to inhibit its use through fear of ‘getting it wrong’.

Considering the theorised importance of context to architectural colour use, and indeed architectural design in general, it is hypothesised that architects vary
colour use between designs (H-3) (Section 4.4.1.2). The analysis of answers to the five-point Likert-scale question: For all of my designs, I normally stick to a similar colour palette appears to support the hypothesis by indicating that architects preferred to be free to vary colour palettes between designs. This finding is reinforced by analysis of how architects described the colour palettes of their two nominated designs using 24 adjectives, which confirms that architects described their colour use differently between designs. Despite some differences between adjectives chosen by different genders and countries, the results also show interesting similarities; both genders and countries most commonly described their colour palettes as beautiful, successful and context-sensitive, while flamboyance received the lowest scores from both genders in both countries. It might be concluded that although architects wish to be free to vary colour use between designs, the majority consistently aim to use quiet (not flamboyant) colours to create sensitive designs that consider context and users. Further research might usefully investigate whether users believe that architects consistently achieve these aims.

5.7 SUMMARY OF DISCUSSION CHAPTER

This section has discussed the many factors that inform architects’ colour use in their designs, with a focus on the role of education and culture on this decision-making process. To elucidate the implications and interpretations of the aforementioned findings, the following diagram (Figure 5.2) summarises the findings of the analyses conducted in this thesis.
Figure 5.2: Summary of findings of analyses conducted in this thesis.
Chapter 5: Discussion

Figure 5.2 indicates a significant and powerful relationship, as might be expected, between level of colour education and level of colour knowledge; a relationship between level of colour knowledge and colour orientation; a significant relationship between level of colour knowledge and colourfulness of design portfolios; and a small but significant relationship between level of colour knowledge and the colourfulness of two case-study designs. There are, however, no direct significant relationships between level of colour education and colour orientation, or level of colour education and the colourfulness of the architects’ designs and portfolios. Therefore, the findings suggest that, while education might inform how architects use colour, how much knowledge they have about colour and the importance of colour to their designing, education does not inform the colourfulness of architects’ designs, nor their general attitudes to how colourful architecture should be.

A noteworthy and entirely novel finding of this study is that colour use in architecture has two chief influences: (1) colourfulness orientation (which varies little if at all between designs); and (2) contextual variables (the cultural and physical context of a design, the building or building component function and client directives). However, it can be speculated, based on the totality of data both quantitative and qualitative, that context may have a greater role in informing colour (hue) choice than in informing the colourfulness of buildings. Findings also suggest the possibility that what have commonly been previously considered important contextual influences on architectural colour use – such as client preference, building function and use, the cultural/historical context of a design and the physical context such as neighbouring buildings and natural features – may be largely subservient to architects’ personal preferences and prejudices towards colour use.
In short, colour knowledge and design context have little impact on the colourfulness of architecture compared to the significant impact of architects’ personal colour orientation, which consists of colour preference and the potency of their cultural indoctrination. Therefore, the colourfulness of architects’ designs and architects’ general attitudes to how colourful buildings should be are strongly related to their own colour orientation. Moreover, if colour orientation is not informed by higher education or the context of designs (see H-4), it must be informed by attitudes and preferences that have formed largely before the study of architecture. These findings suggest that architects’ colourfulness orientations and some colour (hue) prejudices are likely pre-formed consciously and unconsciously by socio-cultural and religious influences before they are educated. For instance, sacred colours in religion, accepted colours in social norms, and dictated and dominant colours based on climatic condition and local materials influence the importance of specific colours in architects’ designs, but it can be speculated (and could be the subject of future research) that long-term exposure to these influences before architects have learned to design might well also consciously and unconsciously inform their ingrained personal colour preferences. Moreover, the gender of an architect may also inform their colour preferences. The difference between genders’ colour preferences is commonly understood to be mostly the result of learned rules about gendered colours that are informed by religious, cultural and social norms. Some of these gender colour biases have more global reach, such as pink for girls and blue for boys, while others are specific to certain cultures.

Despite the many and varied personal influences on architects’ colour preferences, there are consistencies between the very dissimilar cultures of Iran and Australia. While architects of both genders and both countries can be seen to aim to use colour to create beautiful, successful buildings sensitive to context and users,
the great majority of architects across both cultures avoid flamboyant exterior colour palettes. Moreover, despite differences between favourite and least favourite colours in the different cultures, cold colours are found to be preferred by both Iranian and Australian architects. The reasons for this can only be speculated on and indeed might be the focus of further research, but preference for cold colours is certainly consistent with avoidance of the colourful and reticence in using flamboyant colours – whether informed by insecurity, perhaps fear of criticism or lack of colour knowledge. As the use of bright and prime colours is often associated with child-focused environments, it might also be that warm and flamboyant colours are associated with naivety.

The consequences of such a possibility are important, as the study suggests that how colourful our contemporary buildings are is likely influenced more by architects’ personal preferences than by the contextual variables of designs and by their educational backgrounds, and that more often than not architects’ colour orientations result in buildings with little colour. This lack of colour contrasts with overwhelming interest in and agreement about the important role of colour in architectural design. However, it should be considered that an architect’s colour preferences and tastes can also be influenced by other external pressures, such as materials supply, bombardment with media information and even the tastes of the market (such as real estate dictates). Thus, it can be argued that selection of colour based largely on experience and personal preference, uninformed by colour learning via architectural education, but confused by the pressures of media and fashion, has resulted in fear of using colour with flair and excessive caution in colour selection.
CHAPTER 6:
CONCLUSION
CHAPTER 6 – CONCLUSION

6.1 INTRODUCTION

This thesis has examined the factors that inform architects’ colour choices and focused on the roles of education and culture on this decision-making process. While some studies have considered the relationship between designers’ colour knowledge and its use in contemporary architecture, only a handful of researchers have looked at colour in architectural education and few if any have investigated the role of cultural indoctrination in informing architects’ colour use. Thus, this thesis is one of the first studies to uncover what informs architects’ colour decisions and the roles of education and culture in this process. The results of this study can provide a foundation for the development of guidelines, recommendations and strategies for architectural curricula in relation to colour study. In turn, the research findings of this thesis can nurture increased colour knowledge and colour sensitivity in architects, enhancing understanding of their colour decision-making, to raise the importance of colour discussion in the contemporary world.

In this concluding chapter, Section 6.2 contextualises the issue of colour use and knowledge in the contemporary world, and summarises the methods employed in this study, its findings and their relation to the research hypotheses, and the implications of the findings for nurturing more sensitive and knowledgeable designers. Section 6.3 discusses the original contributions of this study to the field of knowledge. Section 6.4 states the limitations of the study and makes recommendations for future research. Section 6.5 provides recommendations for designers, architects and educationalists, whose decisions will shape not only the coloursapes of our future built environment but also the context of colour knowledge and use in architectural education. Section 6.6 closes this thesis with concluding statements drawn from the above findings.
6.2 WHAT HAS BEEN RESEARCHED AND HOW?

This thesis grew out of a concern that developments in both architectural materials and representational technology are transforming the colour palettes and identities of cities by juxtaposing or replacing vernacular colours with colours that are little informed in relation to their cultural and physical contexts. This erosion of visual culture can disenfranchise inhabitants from their cities and even affect the quality of life. As architects have a significant role in determining the appearances of the buildings that contribute to city colourscape, it might be assumed that colour has a significant place in the education of architects and urban designers. However, the major review carried out in this thesis of the accreditation criteria and standards of architecture education in Australia, Iran and wider afield reveals that colour is largely missing from the core curricula of most architectural schools, so that architects are likely making colour choices based on personal preferences and on practical rather than theoretical knowledge.

Detailed investigation of colour use in the built environment necessitated the development of the framework posited in this thesis that seeks to identify the many and varied factors that influence an architect’s colour use. This thesis has developed such a framework for the very first time and in doing so provides important insight into the role of architectural education not only in architects’ knowledge and understanding of colour, but also in their willingness and attitudes towards colour use in their designs. Thus, this thesis fills a major gap in knowledge within architectural education. Although there has been detailed research into the symbolic meanings and therapeutic uses of colour, and the psychological and visual influence of colour on interpretation of space, there is a paucity of research that has explored the role of education and culture on architects’ colour choice or attempted to identify the many other factors that might inform this decision-making.
To address these topics, a mixed-methods approach was adopted using qualitative and quantitative data collection and analysis techniques both in parallel and sequentially, as discussed in Chapter Four. First a 120-item pilot survey was designed and distributed in 2014 among two groups of participants in Victoria, Australia: (1) postgraduate higher-degree-by-research architectural students; and (2) academics and practising architects. Based on the qualitative and quantitative data from the pilot survey, the hypotheses and research questions were revised to inform the final survey. The final 85-item survey of 274 architects, architectural academics and postgraduates in Australia and Iran has investigated to what extent do design education, colour knowledge, architects’ cultural influences/indoctrination and personal colour preferences, and contextual factors (such as client preferences and the cultural and physical contexts of designs) inform architectural colour use? This is a question, it turns out, that has been largely ignored by research to date. Core to this thesis is the testing of seven hypotheses formulated to elucidate the interrelationships between the many and varied influences on colour choice during the architectural design process. Central drivers of the hypotheses have been informed by the theory that education, culture and the contextual variables of a design are the three most important factors that inform architects’ colour use. As such, it has been hypothesised:

(H-1) The educational background of an architect predicts their colour understanding, and their attitude to colour use when designing, but not their personal colour preferences or actual colour use. The thesis supports the hypothesis in finding that: (1) architects are more considered in their use of colour when better educated about colour; and (2) levels of colour education have little impact on architects’ personal colourfulness and colour preferences or actual colour use.
(H-2) The cultural background of an architect affects their attitude to colour use when designing, their colour preference and colour use. The thesis supports the hypothesis in finding that: (1) the cultural background, specifically country of postgraduate education, significantly predicts how important to architectural design architects perceive that colour is; (2) colour use biases in Iran and Australia are rooted in two main categories: (i) contextual factors and (ii) socio-cultural factors; culture has an influence on architects’ colour preference and choice i.e. Iranian architects prefer bright and vivid colours such as white, red, yellow, while Australians prefer neutral colours such as grey, beige and white in their designs; (3) architects’ general colourfulness preferences and the colourfulness of two of their most recent designs did not significantly differ between Iran and Australia; (4) gender has a significant impact on: the perceived importance of colour in architecture, architects’ colourfulness preferences, their general attitudes to how colourful buildings should be and how colourful architects’ portfolios were; (5) gender has an impact on architects’ colour preferences and choices when designing; (6) there is a significant relationship between gender and least favourite colours; (7) both genders chose cold colours as their favourites and warm colours as their least favourites; (8) cultural indoctrination seems to play little role in colour preference, because both Iranian and Australian architects chose cold colours as their favourites and warm colours as their least favourites; (9) gender and cultural background have an influence on architects’ attitudes towards differentiating interior and exterior colour use; and (10) architects’ colourfulness orientation clearly affects how colourful their buildings are.

(H-3) Architects’ colour use will vary between designs. The thesis supports the hypothesis in finding that: (1) architects prefer to differ in their colour use for different designs rather than sticking to a similar colour palette; (2) context is
nominated as the most influential factor on architects’ actual colour use (hue choice) in their designs, but it has no impact on the colourfulness of designs; (3) colour is used differently between designs according to the desired perception of space; (4) when comparing different design outcomes (case studies 1 and 2), each design rated quite differently the importance of influential contextual factors; and (5) the typology of the design, perception of space, the relative importance of standing out or blending in and the psychological impact of colour highly to moderately influence architects’ colour selections for their designs.

(H-4) The higher the level of an architect’s colour knowledge, the more colourful are their designs. The thesis supports the hypothesis in finding that: (1) architects were freer in their use of colour when they had higher levels of colour knowledge; (2) the more colour knowledge that architects had, the more colourful were their design portfolios; and (3) lack of knowledge leads to reluctance to use colour, perhaps because of fear of using it inappropriately.

(H-5-A) Of the multiple influences on the use of colour in built environment design (architects, clients, LPAs, urban designers, colour consultants and design contexts), architects perceive only the clients and the designs context as significant. The thesis supports the hypothesis in finding that: (1) architects are the highest influence on the colour of the built environment, followed by the physical and cultural context of designs and then the clients; (2) clients/users, material importers, dealers and suppliers, and also artists/painters are suggested as other significant influential factors on colour use; (3) media such as social media, TV and design journals were suggested as resulting in the creation of new fashion trends and changing public colour tastes; and (4) the taste and preference of real estate agents were also suggested to influence the use of colour in contemporary cities, especially in residential neighbourhoods.
(H-5-B) Of the multiple influences on an architect’s actual colour use (architects, clients, LPAs, urban designers, colour consultants and design contexts), only the architects, clients and design context are significant. The thesis supports the hypothesis in finding that: (1) architectural teams are found to be the most influential factors on architects’ actual colour use, followed by the physical and cultural context of designs and then the clients; and (2) interior designers and LPAs minimally influence architects’ actual colour choices for their designs.

(H-6) Of the general factors that inform an architect’s colour use (colour knowledge, culture, attitudes and preferences), architects perceive that knowledge has the greatest impact. The thesis partly contradicts the hypothesis in finding that: (1) the physical and cultural context of designs were perceived to have the greatest impact on colour use, respectively followed by perceived impact of attitude and preference, client preference and finally colour knowledge and culture; (2) colour knowledge has a small impact (moderately to somewhat) on architects’ colour use; and (3) colour use is more influenced by context and personal colour orientation than by architects’ colour knowledge.

(H-7) Architects see that of the three general contexts for colour use (exteriors, interiors and landscape), colour is of most importance to interiors. The thesis partly rejects the hypothesis in finding that: (1) colour is the most important for exteriors; (2) the importance of colour consideration for building exteriors, in comparison to building interiors and landscape, results in excessive caution or even fear in the use of colour for building exteriors; and (3) the use of colour to contrast with or blend a design into its context, and also to encourage a psychological/emotional response, are both functions of colour that were seen as very important to the design process.

The major findings of this thesis, which are entirely novel in the sphere of design research and thus represent original contributions to the field, suggest that
colour use in architecture has two chief types of influences: (1) colourfulness orientation (architects’ deep-rooted attitudes and prejudices towards colour use, which vary little if at all between designs); and (2) contextual variables (specific to each design, but which have a greater role in informing colour (hue) choices than the colourfulness of designs). The study suggests that the personal cultural values of an architect – such as their cultural background, personal taste, social norms and even religion – have significant influence on their personal attitudes and preferences towards colour use. On the difference between Iran and Australia, Iranian architects identified the dominant colours of their designs as red, white and bright and vivid colours, while Australians were more conservative, nominating grey, beige and the natural colours of materials.

It has also been found that there is a significant correlation between colour knowledge and architects’ self-ratings of the colourfulness of their design portfolios. Thus, the more colour knowledge that architects had, the more colourful they perceived their design portfolios were. Thus, it is suggested that lack of knowledge leads to a perceived reluctance to use colour and/or fear of using it inappropriately. This finding is an important one for educationalists and also for society in general, for it may imply by extension that architects’ lack of colour knowledge influences the colourfulness of their designs and also affects their actual colour (hue) choice.

The overall findings suggest that the colourfulness of contemporary buildings is influenced more by architects’ personal preferences and socio-cultural and religious influences than by contextual influences such as the cultural and physical context of a design, building function or client directives. Although the results show overwhelming agreement on the central importance of colour in architectural design, the great majority of participants had received insufficient colour education and the majority claimed just an average level or less of colour knowledge. Thus, this thesis
shows that there is a clear gap between levels of colour knowledge perceived as required for architects and the design education that they have received. It is therefore unsurprising that the study shows education has little role at present in informing architects’ colour orientations or their use of colour when designing.

In conclusion, to achieve appropriate city colourscape, there are strong needs to improve colour education in architectural curricula; and to teach architects about the psychological influences of colour, how colour use in design could be better informed by contextual and cultural influences to better meet the needs of communities, and how their own personal colour orientations could be compromising these needs. In particular, the highly subjective impact of personal design preferences on the colourfulness of our cities and buildings needs to be communicated to educationalists.

6.3 CONTRIBUTION TO THE FIELD OF KNOWLEDGE

This thesis has developed a comprehensive understanding of different factors that can influence architects’ colour preference and use in their designs. The thesis has brought together fragmented research findings from across the fields of anthropology, philosophy and art, to physics, colour therapy, environment and health, psychology and architecture. A further unique contribution is the elucidation of the influences of culture and education on architects’ colour knowledge, choice and use. Thus, the thesis has begun to unravel the complex interrelationship between two aspects of colour use – colourfulness and colour (hue choice) – and two chief groups of influences: colourfulness orientation (the deep-rooted attitudes and prejudices towards colour use that are largely consistent from one design to the next); and the many and varied contextual variables that are specific to each design, but which have a greater role in informing colour (hue) choices than the colourfulness of designs.
While Bergström (Bergström. B 2002) outlines the power of colour to make a positive impact on human lives through correct use and Minah (2013) raises awareness about the issue of the ethics of colour use due to lack of knowledge among architects and urban designers, no previous research has addressed how architects make their colour choices. Due to the absence of research on the range of factors that might influence architects’ colour use, this thesis has developed an entirely novel framework that has been tested through a comprehensive survey.

6.4 STUDY LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

Research in the field of colour is difficult and has various limitations. The interpretation of colours largely depends on factors such as cultural, educational and training backgrounds, the observers’ mental and physical conditions, eyesight, preferences and the particular situation. Consequently, the highly subjective nature of colour intensifies the difficulty of understanding this phenomenon and discovering its impact on humanity. Due to the complexity of these issues, this dissertation is unable to discover factors affecting architects’ colour choices such as physiological status. Moreover, as the thesis has not considered in detail the relationship between the design process and the consideration of colour, it is unable to elucidate how and when colour consideration informs the design process. Thus, some questions remain to be answered, such as: do architects initially choose colour or do they choose materials first and then colour preference comes later?

As this study is one of the first to elucidate what informs architects’ colour choices, there were very few prior assumptions or identified variables that could be used to answer the research question. Thus, the study has had to identify, largely from afresh, the variables that might influence colour use. This has been achieved via a literature review and a pilot survey, which have then informed a theoretical
framework relating the possible variables affecting colour choice. As these variables are numerous and wide-ranging, the survey designed to measure their comparative importance was a lengthy one. As it took 30–40 minutes to answer, many participants did not complete the survey, meaning participant numbers are lower than hoped for. Moreover, due to time and pragmatic limitations, the study has only been conducted in the two countries of Iran and Australia. Therefore, these findings should be used with caution in global contexts with regards to the influence on architects of their cultural backgrounds.

As this thesis is almost entirely novel, it is also likely that the possible variables affecting colour use covered in the survey do not represent the complete picture. Further studies may reveal additional influences. There is also the opposite likelihood that the survey was too comprehensive, trying to examine the many and complex interrelationships between too many variables. Thus, the understandings revealed with regards to all of these variables may be less detailed and nuanced than a more focused study might have achieved.

6.5 RECOMMENDATIONS FOR EDUCATIONALISTS AND FURTHER RESEARCHERS

Despite the overwhelming agreement revealed about the importance of colour training in architectural education, the findings of this thesis also reveal the absence of sufficient and well-designed colour courses in the architectural curricula of most design degrees globally, especially in Iran and Australia. Although in some projects the context and function of the building have greater influence on the use of colour due to the perceived requirements of its users i.e. in the design of elementary schools and kindergartens, it has also been found that the colour use of architects appears to be influenced more by their personal colour orientation and cultural indoctrination than by design context and educational and theoretical knowledge. It may even be
likely that when architects are designing buildings such as hospitals and kindergartens where there is a wealth of knowledge on the importance of colour choice, their colour choices may be highly influenced by their own colour orientation and level of colour knowledge. This is a question that might usefully form the subject of future research.

Based on the findings of this thesis and the posited framework of influential factors on architects’ colour use, educationalists might reconsider the role of colour teaching in architectural and urban design curricula. The findings also suggest that colour theory becomes divorced from its practical use if basic colour knowledge is taught without a sense of the impact of colour on design outcomes, the possible roles of colour in the design process and the different considerations that should inform colour use. While the cultural indoctrination and personal colour orientation of an architect have been shown to have significant influences on their colour preference and use, it has also been shown in this study that increased colour knowledge, which may include awareness about the potency of colour and its influences on human life, increases an architect’s willingness to use colour in their designs. Thus, better training might not only lead to more colourful cities globally, but, if this training is well-designed, it should ensure that this colour enhances human experience and enjoyment of the built environment.

6.6 CONCLUDING STATEMENT

The hypotheses of this thesis are largely supported in that increased colour knowledge and better colour education have been found to improve design awareness of the potency of colour to influence human life and to increase architects’ willingness to use colour in their designs. However, the results also suggest that the colour use of architects is influenced more by personal colour orientation and cultural indoctrination than by design context or colour knowledge.
In this sense, although an architect’s colour orientation appears to be formed before their architectural educational, good colour education is still seen to be able to improve theoretical knowledge about, for example, the influences of colour on users’ psychology and physiology, and might also make architects aware of how much their own personal preferences can relegate contextual influences on design. Thus, good colour education can inform appropriate colour use based on sound ethics and professionalism.

Detailed analysis has also indicated that the colourfulness of an architect’s designs is influenced more by the aspects of cultural indoctrination that influence personal colour orientation – which include their gender and the cultural potency of colour in the country in which they completed the later stages of their design education – than by design context. Therefore, it can be speculated that by increasing architects’ awareness of the potency of colour and its multilayered influences on quality of life and wellbeing, education might serve to redress the balance between architects’ subjective biases and preferences in favour of more objective context-related influences that acknowledge the many functions of colour. This research not only provides a critique of colour education, but also attempts to recognise the other influential factors on architects’ use of colour in the built environment. As such, the results of this research will encourage architects and educators to pay greater attention to colour education and knowledge as efficacious and integral factors in the design process that can inform colour use that is conscious, ethical, well-informed and not inhibited by fear, and as a consequence lead to improved colourscape and enhance the overall quality of our built environment.
References

AIA 2008, 'Tertiary education of architect policy'.


Anter, K.F, BM 2010, "Colour research with architectural relevance: How can different approaches gain from each other?", Color Research & Application.


Batchelor, D 2000, Chromophobia, Reaktion Books.


Berlin, B & Kay, P 1969, Basic Colour Terms: Their Universality and Evolution, University of California Press, Los Angeles.


References


Birren, F 1978b, Colour Psychology and Color Therapy; Historical, Biological, Psychological and Visual Aspects of Colour, Van Reinhold Company Inc, New York, USA.


Boeri, C 2010, 'A perceptual approach to the urban colour reading', paper presented to Colour and Light in Architecture_First International Conference, Knemesi, Verona.


CARLA 2016, What is Culture?, Center for Advance Research on Language Acquisition (CARLA), University of Minnesota2016.


References


Derrida, J 1981, Dissemination, University of Chicago, Chicago.


Eagly, AH & Chaiken, S 1993, The psychology of attitudes, Harcourt Brace Jovanovich, Fort Worth, TX.


Fiedler, Je 2006, Bauhaus, Konemann, Berlin.


Gage, J 1999, Color and culture: practice and meaning from antiquity to abstraction, University of California Press, Berkeley, Calif.


Goldstein, K 1942, "Some experimental observations concerning the influence of color on the function of the organism", *Occupational Therapy*, vol. 21, no. 147-151.


Hutchings, J 2006, 'Talking about color ... and ethics', *Color Research and Application, Wiley Subscription Services, Inc*, vol. 31, no. 2, pp. 87-9.

Itten, J 2003, *The elements of color; A treatise on the color system*, John Wiley & Sons, INC.


Kobayashi, S & Sato, K 1977, 'The theory of the color image scale and its application', paper presented to AIC

Koller, V 2008, 'Not just a colour': pink as a gender and sexuality marker in visual communication', *visual communication, SAGE Publications*, vol. 7, no. 4, pp. 395-423.


Kwallek, N & Stovall, L 2010, 'A Multidisciplinary Approach in Teaching Color to First Year University Students', paper presented to 2ND International Conference On Design Eduaction, SYDNEY, AUSTRALIA.


Lancaster, M 1984, Britain in view : colour and the landscape, Quiller Press, London.


Macha, J 2015, Wittgenstein on internal and external relations, Tracing all the connections, Bloomsbury Academic, UK, USA.


Minah, G 2013, 'Color and Altruism: the Architecture of Background', paper presented to AIC- 12th International AIC congress, Newcastle upon Tyne, Uk.


Munsell, AH 1905, *A colour notation: a measured colour system, based on the three qualities hue, value and chroma with Illustrative model, charts and course of study arranged for teachers*, G. H. Ellis Co, USA.

Munsell, AH 1912, 'A pigment color system and notation', *American Journal of Psychology*, vol. 23 no. 2, pp. 236-44.


Nijdam, NA 2006 'Mapping emotion to color'.


Plater, G 1967, 'Adolescent preferences for fabric, color, and design on usual task', Indiana State College.


Smith, D 2003, 'Environmental colouration and/or the design process', *Color Research & Application*, vol. 28, no. 5, pp. 360-5.


St. George, MV 1938, 'Color preferences of college students with reference to chromatic pull', *learning, and association, ibid*, vol. 51.


Timothy, T, Rogersa, b, Pattersonb, K & Kim, G, c 2007, 'Colour knowledge in semantic dementia: It is not all black and white ', *Neuropsychologia* vol. 45, pp. 3285–98.


APPENDIX A:
PUBLICATIONS
APPENDIX A – PUBLICATIONS

THE ETYMOLOGY OF A COLOURFUL DESIGN LANGUAGE: HOW DO WE DETERMINE WHAT INFORMS ARCHITECT’S COLOUR CHOICES?

Bahareh Motamed and Richard Tucker, Deakin University


**Abstract**

The development of materials and visualization technology is transforming the colour palettes of cities. As architects have significant roles in determining the appearance of buildings that contribute to city colourescapes, it might be expected that they have considerable colour knowledge. However, there is largely an absence of colour training in built environment education outside of interior design, meaning architects are likely making colour choices based on practical rather than theoretical knowledge. This prompts the question: what informs the architect’s colour choices? While colour has been studied in a broad range of disciplines, few studies have focussed on the built environment and even fewer on how and why built environment designers choose colours. This article explains the origins and development of a framework for understanding factors that influence architects’ uses of colour. The framework has informed a national survey in Australia to determine how personal and educational experiences have affected the use of colour.

**Keywords:** colour knowledge design education design architecture architectural education cultural background

**Introduction**

Despite the significant role of architects in determining colour use in the built environment, few studies have focused on colour use and understanding in architectural design. A key question remains unanswered: ‘what informs architects’ colour choices?’ This study investigates the impact of a wide range of factors on
Appendix A

colour knowledge and use in the built environment. It describes the three-stage development of a theoretical framework for understanding what these factors are and what the relationship might be between them. In the first stage, a preliminary framework was informed by reviewing the literature on colour use in a wide range of contexts. In the second phase, the viability of the preliminary framework was tested through a pilot survey of a small sample of architecture students, academics and practising architects from Victoria, Australia. The findings of the pilot suggested that some of the factors suggested by the literature to be important appeared unimportant to architects, whereas other factors not directly considered in the pilot were identified in qualitative comments to open-ended questions. In the third stage, the pilot survey findings informed a refined framework leading to a second more comprehensive survey instrument currently in circulation among students, academics and architects across Australia and also, in order to investigate the possibility of cultural differences, in Iran. Figure 1 indicates the three developmental stages of this study.
Context And Background

Colour is an integral part of studies in multiple fields with different perspectives, such as physics, philosophy and psychology. Based on its impacts on mood, perception and interpretation, colour can have an important role in architecture. Built environment designers, such as architects, play significant roles in designing our city colourscape – creating interior and exterior spaces coloured in ways intended to improve experience and comfort, and also to express meaning and idea. It is argued that designers can make a positive impact on human lives through their design colour choices (Bergström 2002). But how do architects use colour, and what factors influence their colour choices? Considering the subjective, complex and multidisciplinary nature of colour use, many diverse factors have been identified to have an impact on human colour preference and colour choices. The
following passages summarize this literature to suggest which of these factors may be pertinent to built environment designers.

**Human characteristics**

The literature suggests a bilateral relationship between the human physiological and psychological status and colour preference in everyday life. A person’s colour vision acuity is one fundamental factor affecting colour use and preference. It has been argued that human vision is able to distinguish between two–ten million different colours (Gouras 1991; Pointer and Attridge 1998). However, individual differences in human colour vision and visual disabilities, such as different types of colour blindness, may result in different colour perceptions. According to estimates by the Howard Hughes Medical Institute in 2006, approximately 7.0 per cent of the male population and 0.4 per cent of the female population suffer from colour vision disabilities, most of whom cannot differentiate red from green or perceive them differently to other people (Mandal 2014). Due to differences in emotional and physiological status, Bilmer suggests that gender should also be considered as an influential aspect in visual colour perception, preference and thus choice (Bimler et al. 2004). Colour acuity is also influenced by ageing, for age-related physiological changes in the retina and visual nervous system result in a gradual decline of visual function, quality and sensitivity to colour contrast (Ou et al. 2012; Pinheiro and Da Silva 2012).

**Colour symbols and meanings**

The wall paintings of primitive peoples such as those found in Lascaux and Altamira demonstrate the long-held perception of colour as engendered with spiritual qualities with cultural significance (Porter and Mikellides 1976). The symbolic meaning of colour has been celebrated across cultures in religious and morals domains relating to customs, beliefs and habitat (Lenclos 2004). For
instance, in Islamic countries such as Iran, green is the symbol of resurrection and recalls the ‘garden of delight’ to its believers. In the Mayan culture the cycle of life has been represented by five symbolic pigments: Red as a symbol of blood and birth, yellow for nourishing corns, blue-green for water and fertility, black for death and white for mutation (Lenclos 2004). It follows that cultural–religious distinctions in colour meanings may affect popularity and use of specific colours in different societies. According to the findings of Lenclos’ geographical colour survey across cultures (2004), a significant difference between different cultures in terms of the importance, value and use of colour may consciously or unconsciously affect colour selection and preference.

Colour naming

Language is an important tool for colour recognition in any society. The study by Maerz (in Maerz and Paul 1953) and that by Berlin and Kay (1969) on colour language reveal lack of sufficient vocabulary for naming and differentiating colour in many languages (Berlin and Kay 1969; Maerz and Paul 1953). Therefore, it has been argued that the limitation of colour naming for distinguishing colours may affect the perception and recognition of local colours (Gage 1999), which may also have an impact on colour selections and preferences in societies.

Vernacular colour

According to Swirnoff, local colour palettes have been developed historically by communities as a response to what is termed a ‘vernacular eye’ to the environmental features and local habitat (2000). Similarly, in the theory of ‘the geography of colour’, Jean Philippe Lenclos also argues that geographical factors have resulted in the expression of different colour palettes in different regions. Although the selection and use of ‘vernacular’ colour is often based on similar rules for different locations, the vernacular ‘gestalt’ and expression differs remarkably
from place to place according to geographical, religious and climatic conditions (Lenclos 2004). Thus, vernacular colour preference is seen to shape the perceptual experience of and determine national, regional and local place identity. Accordingly, the vernacular colour palette is recognized as a component of the visual and cultural language of any region (Lenclos 2004; Swirnoff 2000). In this sense, the colourscape of a region can be seen to depend on numerous factors, including geographical situation (latitude and altitude, which define the angle and intensity of sunlight), homogeneity of architectural character, climate, natural features, chromatic expression of a given region or country based on their aesthetic tastes, religious beliefs and other sociocultural influences (Lenclos 2004). For example, using building materials and surface finishes of light colours with high reflectivity in a hot desert is based on the need to maximize the reflection of sunlight from surfaces in order to keep the dwellings cool.

**Philosophy and concept**

Although use of colour in the decoration of habitation has been seen since the time of early cave paintings, it is argued the colour history of architecture shows that colour has remained largely subservient to line for representing meaning, and thus is normally treated as an adornment to form and object (Motamed et al. 2015b). The two factors informing historical colour use in architecture most commonly discussed in the literature are (1) contemporaneous philosophy and style, and (2) colour in relation to design intent. As shall be discussed now, style in colour is as ephemeral as the other expressions of style. From the Renaissance until the mid-nineteenth century, the misconception of a monochrome ancient Greek architecture has been reflected in the lack of colour use in classical facades. This long-held view of a colourless antique world was changed by Hittorff’s mid-nineteenth-century discovery of ancient Greece’s love of colour. Yet the impact of this new perception
of a colourful antique world was far from immediate in art and architectural (Motamed et al. 2015b). After the industrial revolution, criticism of the monotony of industrial cities raised attention to colour and inspired scholars such as Munsell and Ostwald to devise colour classification systems. In the twentieth century, the appearance then of short-lived movements such as De Stijl and the teachings of the German school of Bauhaus informed a different perception about the relationship between art, architecture and especially the use of colour. De Stijl members believed in the power of colour to add a new dimension to architecture that could be inseparable from the architectural structure (Caivano 2005; Porter 1982). The imperative to build many buildings quickly after World War II, combined with lower construction costs and also the rise of modernism, once again changed designers’ attitudes towards colour. Yet despite the combined stylistic impacts of the white international style, Purism and Ludwig Mies van der Rohe’s famous aphorism ‘less is more’, modernism did not actually advocate non-colour. Instead, the modernists’ discussion gave expression to different attitudes towards colour and its application. Trends changed again in the late 1980s and 1990s, reflected by Robert Venturi’s postmodern counteraphorism ‘less is a bore’ (Minah 1996). Figure 2 indicates some of the key people, movements and events affecting the use of colour in architecture over this period of history. While the fashion impacts of intellectual movements and architectural style have had influence on colour use in the built environment as in the other visual arts, the design concepts and aims of architects are also seen as influential in colour selection and use.
It is argued that the sombre and repetitive appearance of buildings after World War II, together with the raised attention in the early 1980s on urban renewal and the quality of the public domains of the built environment, resulted in a change of design attitudes towards colour (Linton 2002). The use of colour in the design of Georges Pompidou Centre by Renzo Piano and Richard Rogers (in France), the work of Michael Graves (in the United States), Paolo Portoghesi, Aldo Rossi (both Italy) and Mario Botta (Switzerland) are notable examples of this new attitude towards colour in the late twentieth and early twenty-first–century architecture.
Recognizing the power of colour to draw a viewer’s attention and thus inform interpretation, designers such as Barragan have used colour to define form, and express building structure, function and services. Colour is also used to express planning logic through way-finding and orientation strategies (Smith 2008), or as a means of blending in or differentiating a building from its surroundings. Colour in architecture is also employed metaphorically to convey the senses of specific moods or feelings. Indeed, research attests to a strong relationship between colour and well-being (Carruthers 2011; Birren 1978; Lechner 2011), with therapeutic impacts claimed for different colours through impacts on attitudes and behaviours (Lüscher 1971; Gimbel 1994). For instance, Dalke and Matheson (2007) show that the use of appropriate colours may enhance moods, reduce undesired behaviour and accelerate the healing process. The result of such research has raised architects’ awareness about the use of appropriate colour in the design of healing and learning spaces, such as hospitals wards, waiting rooms, classrooms, prisons and workspaces (Parkes and Volpe 2013).

**Colour knowledge**

Despite the long-held but differing opinions on the importance of colour in architectural design, the literature suggests that colour is rarely a subject of serious enquiry in design practice and education. In the domains of architectural theory and practice, colour is predominantly considered as secondary to characteristics such as form, line and structure (Minah 2013), or as a supplemental concern that is largely a matter of personal expression and manner (Durao 2012). Desktop survey of degree programmes in the United States, United Kingdom and Australia reveals that colour has been dropped from the core curriculum of the vast majority of architectural schools in these locations. It follows that lack of colour consideration in architectural education might be reflated by a lack of confidence in or even fear of using colour
Appendix A

conspicuously in architectural practice and design. Despite such a possibility, few studies have considered the relationship between designers’ colour knowledge and its use in contemporary architecture, and only a handful of researchers have looked at colour in architectural education. Minah (1996, 2013) and Bergström (2002), for instance, have drawn attention to a serious need for adding colour study into architectural education, and Kwallek and Stovall (2010) have preferred a pedagogical model for improving students’ colour knowledge through both theoretical and experimental courses. The Kwallek-Stovall model seeks to increase student awareness, from the beginning of their study, of their professional responsibility for the impacts of their colour choices on society (2010). Other researchers have highlighted communication problems around colour knowledge due to the theoretical basis and development of colour knowledge and use in different disciplines, each with their own professional language. In this regard, Vezzani, in her 2009–2012 study, suggests a toolkit ‘Colour Design Edu. System’ (CDES) to improve colour knowledge communication between disciplines (2013). Vezzani has tested the CDES in design classes with the aim of developing a shared colour culture in step with the complexity and interdisciplinarity of contemporary practice. Similarly, O’Connor (2010) believes that lack of willingness of architectural schools to teach colour is a result of ambiguity and confusion in colour theory and colour knowledge communication. O’Conner suggests a need for revising the approaches to colour teaching in architecture in consideration of the absorption of colour theories from other knowledge domains, which includes the ontological assumptions of diverse theoretical paradigms. In a 1998 study, Janssens and Mikellides focused on the educational basis of architects’ colour knowledge, investigating what architectural students know ‘about perceptual and psychophysiological aspects of colour, colour nomenclature, existing myths and
Appendixe A

beliefs, and how colour is used in their everyday work in studios’ (1998). Here they conducted surveys and interviews in architectural schools in Sweden and Britain to test how knowledge of colour was informed by the training that students had received. The findings indicate a severe lack of knowledge about colour and colour research in both cohorts of students (Janssens and Mikellides 1998). Although the Janssens and Mikellides’ study is cross-cultural, they did not investigate the possibly important influence of cultural difference on colour knowledge and understanding, which is an area of enquiry that requires further study. In 2003, Smith developed research to answer the question ‘is colour considered important in the design of our built environment by those who practice design, such as architects and interior designers?’ The framework of the study, which surveyed interior designers and architects, is based on four aspects informing the understanding of design practice: (1) conceptions of designing, (2) understanding the nature of the built environment, (3) ‘place’ formation, and the architectural experience and (4) style, fashion and the everyday discourse of environmental colouration. The findings of the research reveal a number of factors that may affect the choice of colour by architects: organizational and/or personal colour preference and style, context, building typology, end-user preferences and innovation (Smith 2003). It should be added, however, that these findings must be interpreted with caution because of the study’s small sample size – which consisted of only sixteen participants. It might also be argued that any complete picture of the reasons behind an architect’s colour choices should also include the influence of education as well as practice. In another article from 2008, Smith suggests that the impact of colour on experience and interpretation of the built environment can be studied by examining shifts in understanding and perception of buildings when they are viewed via achromatic images compared to when they are viewed via naturally coloured images (Smith 2008). Smith argues
that colour affects the emotional connection and disconnection between people and spaces, a position backed up by a follow-up study (Smith and Demirbilek 2009) finding that the impact of colour includes a shift in perception of aspects of an environment ‘such as its atmosphere and youthfulness’ (Smith and Demirbilek 2009). In the investigation described in this article, a pilot survey was developed, informed by the literature, to identify the design process influences and personal, cultural and educational experiences that informed colour choice and understanding in architects, academics and students.

Method

The structure of the 120-item survey was based on the Janssens and Mikellides instrument (1998). However, while sections I and III of the pilot largely repeat the Janssens’ survey, section II contains an additional series of questions on participants’ colour knowledge and the factors informing their colour choices. Table 1 shows the structure of the survey, which was divided into three sections and nine blocks. The first section asks about participants’ personal and educational background. Section II, divided into four blocks, examines colour use via the impact of four factors drawn from the literature: (1) Personal background and ability, (2) Knowledge and education, (3) Experience in practice and (4) Environmental and human needs. This section contains both a Likert-scale (from 1=strongly Disagree to 5=strongly agree) and open-ended questions. Lastly, the third section asks participants about colour research and education. The pilot was distributed in 2014 among two groups of participants in Victoria, Australia: (1) postgraduate higher-degree by-research architectural students (HDRs) and (2) academics and practising architects.

Table 1: The structure of pilot questionnaire. (Contents that have been informed by Janssens and Mikellides has been marked with *).
Appendix A

Pilot Survey Results And Discussion

The following is a summary of the results of the pilot published elsewhere (Motamed et al. 2015a). In total, 33 completed questionnaires were received. Gender distribution was fairly evenly split: 57 per cent men, 41 per cent women and 3 per cent who preferred not to mention the gender. Both genders held similarly positive views on the importance of colour in architecture. Overall, 100 per cent of females and 92 per cent of males saw colour as very or moderately important (M=4.5, SD=3.6). Gender, therefore, appeared not to be an influential factor on the level of importance attributed to colour in architecture. While 86 per cent of the participants believed that colour played an important role in the design process, 50 per cent
declared their lack of any colour education at architecture school. While the other half claimed they had received some colour training, the majority described this was basic and mostly done via the process of designing in a ‘studio’ assignment or as a part of a course not focusing specifically on colour. No participants had been required to enrol in a compulsory course focusing on colour. While colour seemed to have played a very minor role in the participants’ higher education, nearly half felt that this deficiency should be addressed, agreeing that ‘higher education should play a role in informing knowledge about colour use in architecture’. It has been suggested that the level of colour consideration in architectural curricula may have a relationship with the country of study and its educational system (Madden et al. 2000). In order to test this possibility, participants were asked to state the country of their design degrees. As the cultural origins of the participants were widely spread, with sparse representation across the range, regional patterns could not be detected. However, results revealed a relationship between prominence of colour in architectural curricula and the cultural prominence of colour in the country of study (Motamed et al. 2015a). Codifying qualitative responses to questions investigating the specific influence on colour use of where the participants practised, taught and studied – i.e., Victoria (and mostly in Melbourne and Geelong) – revealed several influential factors, with the two most often cited being: the advent of new materials with broad colour palettes, and the impact of key city projects and award-winning designs publicized through the media. While the influence of the academic context of the study was also investigated, only 12 per cent felt that the design aesthetic/design-philosophy/stance of their school had significantly affected colour use in their own designs. Moreover, only 48 per cent agreed or strongly agreed that ‘higher education had an impact on my understanding and use of colour’. In contrast, almost 72 per cent felt that their practical experience had a highly or moderate
impact on their use of colour. The relative importance of eight design factors on colour use, as identified from the literature, were then assessed: function, decoration, cultural context, historical context, design intent (concept), climatic and geographic context, the perceived meaning of colour, and the colour of the surrounding built environment (Figure 3). While the literature stresses the importance to designers of the symbolism of colour, the symbolic ‘meaning of colour’, alongside its use purely as ‘decoration’, was rated as the least influential design considerations. The ‘surrounding built environment’ and ‘climatic and geographic conditions’ were seen as the most important influences on colour choice, with 42 per cent of the participants rating these as highly important design considerations. The remaining five factors were seen as of a moderate importance.

![Figure 3: The impact of eight factors on colour choices for architectural.](image)

Four sociocultural influences were also rated: client/stakeholder aesthetic preferences, the symbolic meaning of colour within the specific cultural context of the design, the socio-religious value and meaning of colour within the specific cultural context of the design, and the personal colour preferences of the designer (Figure 4). Here, client taste was identified as the dominant influential factors in colour choice.
A further series of questions investigated who is now responsible and who would best be responsible for colour choices in the built environment. While 76 per cent agreed that architects have significant responsibility for the colour of the built environment, qualitative data revealed client/stakeholders as having the greatest impact on colour choice. Identified as the next most influential were planning authorities, followed by lifestyle trends and architectural magazines, and then architects. When asked ‘who should make decisions for cities about the architectural use of colour?’ 80 per cent believed that architects should be least partly responsible, with qualitative comments indicating a clear belief that architects should make colour decisions in collaboration with other professionals (48 per cent of the comments) (Figure 5).
Figure 5: Influence of different professionals or people in architectural use of colour.

Codifying of open-ended questions via grounded theory revealed other factors not specifically referred to in the pilot survey. For instance, the advancement of digital technology was identified as a key enabling factor in the majority of answers to a question about change in colour use over time. Here, many participants stated that advancement in digital technology has changed their attitudes and willingness to colour use by providing a broad colour palette that is accessible and easy to test through design visualization, in contrast with once traditional paper-based methods of representation. In particular, the ability to apply colours and materials in digital 3D models shown in context through montage increased confidence in colour use by providing an accurate in-situ presentation of the final outcome.

Refining The Instrument

Analysis of qualitative and quantitative data from the pilot survey informed a more comprehensive questionnaire for intended circulation in Australia and Iran in 2015. Accordingly, three main actions were implemented: (1) deleting or reducing the number of questions related to those areas identified by pilot participants as unimportant or partly irrelevant; (2) adding questions about factors newly identified
in the pilot qualitative data, such as the impact of technological advances, cultural background, and finer interrogation of clients influence; and (3) changing and adding new question types to the final survey that more readily reveal colour attitudes and preferences – through semantic differentials and response to visual colour-prompts. The changes resulted in a redesigned survey structure with five different types of questions: multiple-choice, open-ended, semantic differential, visual interpretation of images and Likert-scale (Table 2). While the focus of Sections I and II echo the pilot, the content, type and number of questions are different. Section III departs most significantly from the pilot, focusing on the contextual factors impacting individual designs. Block B-1 is on demographics, B-2 on personal colour preferences and attitudes, B-3 on colour knowledge, B-4 on colour education, B-5 and B-6 on contextual influences on colour use and B-8 on the wider context of colour use. Thus,

- In block B-1, two questions are added (to the commonly used demographics) that ask about the role of colour and colour biases in the participant’s home country.

<table>
<thead>
<tr>
<th>Blocks</th>
<th>Specific content</th>
<th>Multi-Choice</th>
<th>Open Ended</th>
<th>Likert Scale</th>
<th>Images</th>
<th>Semantic differential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section I</td>
<td>B-1 Demographic</td>
<td>✓</td>
<td>✓</td>
<td>……</td>
<td>……</td>
<td>……</td>
</tr>
<tr>
<td>Section II</td>
<td>B-2 Personal Colour Preference and Attitude</td>
<td>✓</td>
<td>✓</td>
<td>……</td>
<td>……</td>
<td>……</td>
</tr>
<tr>
<td>B-3 Colour Knowledge</td>
<td>✓</td>
<td>……</td>
<td>✓</td>
<td>✓</td>
<td>……</td>
<td></td>
</tr>
<tr>
<td>B-4 Colour Education</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>….</td>
<td>……</td>
<td></td>
</tr>
<tr>
<td>B-5 Colour in Practice</td>
<td>……</td>
<td>✓</td>
<td>✓</td>
<td>….</td>
<td>……</td>
<td></td>
</tr>
</tbody>
</table>
In block B-2, personal colour preferences and attitudes are determined, including colour preference on a scale from colourless to colourful, favourite and least favourite colours, and general attitudes and tendencies to colour use for interiors and exteriors.

B-3 is on colour knowledge and allows comparison between architects’ self-ratings of colour knowledge and their actual knowledge. First, participants self-rate their overall knowledge of the use of colour in architecture via a six-point Likert-Scale (from one=none to six=expert). The questions of the rest of the block are in two sections: the first ten items contain more general questions testing colour knowledge, whereas the next ten questions test what might be considered more specialized knowledge. As the literature suggests (Smith [2008]; O’Connor [2011]) that visual questions can facilitate colour imagination and increase participant engagement with question on colour, a number of multiple-choice questions are offered in a visual format in this block (Figure 6).

Block B-4 asks about the level and context of colour education provided at university.
• Block B-5 focuses on design use in practice, including the use of design constants, the relative importance of colour to different design stages, the functions of colour, what influences colour palette ranges and the impact of new technologies.

• Block B-6 questions the relative influences of contextual factors on colour decision-making for all design projects, such as clients, the architect’s own cultural background, planning and other legislative restrictions, and the architect’s own personal colour preference.

• Block B-7 asks participants to nominate two of their recent designs and explain their attitude and preference towards colour use in those two different contexts. The use of two designs provide case studies of the colour decision-making process in two different contexts, thus allowing for an examination of the relationship between context and colour use, and consequently which factors impacting colour use are consistent between projects and which ones vary. Thus, Block 7 includes the importance rating of nineteen generally accepted functions of colour in architectural design (Figure 7). As the pilot survey identified clients as one the most important influences on architects’ colour decision-making, four questions in Block 7 directly explore the relationship between clients’ colour preference and requests and designers’ specific colour choices for the two designs. The last section of Block 7 utilizes semantic differential questions to investigate subjective and less unmeasurable data with more profound implications on how the architects view their use of colour in the two designs. Two types of semantic differential questions are used. The first question, informed by Smith’s study (2003), asks participants to describe the colour palette of their design using 24 listed adjectives. The following two questions consist of seven bipolar scales (Table 3), informed by Ural and Yilmazer’s study (2010), and first identified by Osgood et al. (1957). These two questions ask architects to
describe their colour choice for the exterior then the interior of the two designs on seven bipolar scales. For example, ‘for the first pair, 1 describes your choice of colour palette as “harmonious”, 7 describes it as “discordant”, while a 4 indicates midway between the two extremes’. The intention here is to determine semiotic differentials between interior and exterior colour use. Finally Block 7 includes five questions about designers’ general ideas about relative influential of different stakeholders in colour decision-making, current trends in colour use and innovation, in addition to a space for comments or suggestion about the research.

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>Minimally important</td>
<td>Somewhat</td>
<td>Moderately important</td>
<td>Very Important</td>
</tr>
</tbody>
</table>

- Typology of the design
- The urban density of the site
- Visible natural features
- Colours of immediately neighbouring buildings
- Colours of prominent buildings that are visible from the site
- Historical use of colour at the site
- Building orientation
- Building height
- Building form
- Climatic conditions
- Solar light intensity and angle at the site
- Urban design / planning restrictions
- Cultural context – e.g. customs and religion
- The colour of the building at night
- The psychological impact of colour
- The relative importance of standing out or blending in
- Safety coding
- Perception of space
- Way finding

*Figure 7: “How do you rate the importance of the following contextual influences on your colour selection for this design?”*
Table 3: An example of seven bipolar scales question, which seek participants’ attitude and feeling towards their colour choices for their design.

<table>
<thead>
<tr>
<th>Harmonious/ discordant</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pleasant/ unpleasant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comfortable/</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>uncomfortable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spacious/ confined</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Static/ dynamic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exciting/ calming</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Introverted/ extroverted</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Conclusion**

The literature on colour in architecture confirms an acute lack of research about what factors that might inform architects’ colour choices and the origins of these factors. To understand the many factors that influence the use of colour by built environment designers, especially architects, a framework was developed based on the literature. A pilot survey of a small group of participants tested the viability of this initial framework. The analysis of qualitative and quantitative data from the pilot suggested that while architects in collaboration with other professional were identified as those best placed to make colour decisions, the aesthetic taste of clients was the most influential factor of colour use. The pilot also revealed that technological developments have significantly changed designers’ present attitudes towards colour use, enabling greater confidence through the use of digital representation. A redesigned survey expresses a framework presented in this article for understanding the factors that impact architects’ colour choices. The revised framework identifies six identified categories of factors: (1) human characteristics, which contains designers and clients colour preference and attitude towards colours; (2) architects’ levels of colour knowledge; (3) environmental
features, including climatic, cultural and contextual characteristics; (4) design philosophy and conceptual intent; (5) symbols and meanings; and (6) colour naming. In addition, the influence of technological advancement and visual arts, fashion and trends, proliferated by social media and ‘lifestyle’ designtemed television programmes, must be considered as other factors that have an influence on the colourscape of our environments.

ACKNOWLEDGEMENT

This study was supported by Deakin University, Victoria, Australia. The authors are grateful for this support.

REFERENCES


THE FAIRER SEX: GENDER DIFFERENCES IN ARCHITECTS’ USE OF COLOUR WHEN DESIGNING

Richard Tucker & Bahareh Motamed and, Deakin University

Submitted to Journal of Design Studies

Abstract
This paper considers if the gender of architects, as one aspect of cultural indoctrination, impacts their colour use. A survey of 274 designers asked: does gender affect architect’s general attitude towards colour use, colour preferences and use of colour when designing? It was found that while female architects perceived colour to be more important to architecture than males did, females’ portfolios are significantly less colourful. Gender differences were also found for hue preference, dominant colour use, and the use of colours for building exteriors. The findings provide the design community with more information about the relationship between culture and colour responses. The authors argue for an approach to design education that acknowledges the current primacy of architects’ subjectivity.

Keywords: Architectural design, design education, colour use, decision making

New design representation and building materials technologies have enabled contemporary buildings in cities to be saturated with colour. Here city colour palettes and identities have been transformed by juxtaposing or replacing the colours of vernacular materials with colours that are little informed by their cultural and physical contexts. Although these transitions may result in improvement in some aspects of city life, the advent of globalisation has caused a gradual elimination of vernacular historical colour use that reflected native culture, ethnicity and identity. As colour not only plays a crucial role in preserving city identity, but can also initiate urban and
social regeneration, this erosion of visual culture may impact not only the economic sustainability of the built heritage by discouraging tourism, but may also reduce quality of life and wellbeing due the acknowledged impacts of colour on human psychology and behaviour. For as discussed by Bruno Taut, colour is the most effective, fastest and cheapest means of countering the inexpressive grey of much of architecture, and of awakening the consciousness and perceptual capacities of citizens (Boeri 2010).

Recognising that architects’ colour selections have important cultural, psychological and economic impacts prompts the question: what informs architects’ colour choices in their designs? More specifically, this paper considers if gender impacts the use colour in design. Surprisingly, this question has received very little research attention. For while colour and its use has been studied in multiple fields from many different perspectives, resulting in the recognition of a number of factors informing colour use – such as demographic characteristics (e.g. culture, age and gender), personal preference, and the potency and semiotic interpretation of symbols and meanings – only a small number of studies have attempted to find the impact of these variables on colour use and understanding in design, and fewer still have considered what informs architect’s colour choices. This study aims to shed light on a number of issues, for as well as providing a critique of the role of colour education in informing effective and appropriate use of colour in the built environment, it is hoped that the findings of this study can inform and improve curriculum design and pedagogical approaches for teaching colour knowledge in ways that see colour use become a more robustly informed part of the design process.

To facilitate the investigation of these questions, we have published elsewhere a theoretical framework hypothesising the relationship between the variables that might influence colour choice in building design ((Motamed & Tucker 2016). Figure 1 illustrates the two research stages that identified these variables. The first sought to
identify all variables suggested by the literature across all domains of colour theory and research. In the second phase, these variables were refined via a pilot survey of architecture postgraduates, academics and practising architects based in Victoria, Australia. A final list of seven categories of variables was identified by analysis of quantitative pilot survey findings and (qualitative) participants’ comments: (1) individual demographic characteristics (2) colour education, (3) colour knowledge, (4) culture, (5) colour preference, (6) colour attitude, and (7) design context (practice). Gender, of course, is a demographic characteristic as well as an aspect of culture; in that our cultural indoctrination is influenced by our gender via the attitudes towards gender that are prevalent in the cultural contexts that shape us.
This paper examines the relationship between gender and three of these seven variables: (1) colour (and colourfulness) preference, (2) colour attitude, and (3) colour use in practice. Here, two variables – colour preference and colour attitude – required clear delineation.

**Colour and Colourfulness Preference**

Colour preference might normally be understood as the tendency for an individual or a group to prefer some colours over others, such as having a favourited colour. Colour preference is theorised to depend on the situation/context of colour choice, the underlying associations that people may have developed (Grossman & Wisenblit...
and many other factors such as gender, age and emotional experiences. A preference might also favour monochromatic tones from white to black, and when it comes to complex multi-component objects such as a building, preference might favour a more restricted colour palette over a highly colourful palette. Hence, in this paper, we differentiate between colour (i.e., hue) preferences – that is, a preference for certain colours over others – and colourfulness preference – a measure of how colourful an architect prefers building designs to be.

**Colour Attitude**

In general, *attitude* refers to a relatively enduring organisation of beliefs, feelings, and behavioural tendencies to respond positively or negatively towards a certain idea, object or situation (Hogg & Vaughan 2005). Thus, an individual’s attitude towards colour or a particular colour will affect the person’s choice of colour (Funk & Ndubisi 2006). According to the ABC model (Eagly & Chaiken 1993), attitude in general contains three components: (1) affective component, which is person’s emotions or feelings; (2) behavioural component, which is a person’s intended behaviour (positive or negative); (3) cognitive component, which is a person’s beliefs, values, or opinions held consciously. In this paper colour attitude refers to an architect’s beliefs and behavioural tendencies in relation to colour use in general in architecture and more specifically according to design context e.g., interior or exterior, at different stages of the design process, for different functions of buildings, for different locations, communicating contextually mediated meaning.

In the latter sections of this paper, we will also use the term *colour orientation* to signify a theoretical combination of colour preferences and attitudes i.e., all those preferences, beliefs and behavioural tendencies towards colour that an architect brings to every project and which varies little between projects.
Before looking in detail at the literature on the variables examined in this paper, the notion of colour use in this study requires definition. Distinguishing between colour and colourfulness preference, we suggest two aspects of colour use in architectural design: (1) the colours that architects choose for a design, and (2) how colourful the design is. The differentiation is clear when we consider the portfolios of architects, for it is more common that an architect will be known for colourful buildings than for, say, red buildings. In this paper, we include in our analyses both aspects. It will be shown that although female architects believe colour to be more important to architecture than men do, females perceived their portfolios of designs to be significantly less colourful than males’ portfolios. counterparts. Differences will also found between genders for hue preference, the use of dominant colours when designing and for how colours are used for the exteriors of buildings.

1. Background

Here, we consider the literature relating to colour use and: gender, culture and colour orientation (i.e., attitudes to colour use and colour preference). This includes discussion of gender differences in colour interpretation in relation to physiology, psychology, and cultural semiotics.

1.1 Colour, Human Interpretation and Gender

According to the literature, it is argued that colour interpretation is not just dependent on the external world, but has a strong connection with our internal world, consisting of experience, behaviour, mood and imagination. In this sense, according to Mahnke, the colour should be considered part of our psyche (Mahnke 1996, p. 8). The theory of planned behaviour proposed by the psychologist Icek Ajzen (Ajzen 1991), which focuses on influences on the creation of human intention and behaviour, can be used as a framework to identify the factors that may affect individuals’ (and specifically
Appendix A

architects’) behaviour and intentions towards colour choices. The theory consists of three determinants of intention that can predict human behaviour: (1) attitude towards the behaviour, which refers to the personal evolution of behaviour; (2) subjective norms, which refer to socially expected behaviour in different situations; and (3) perceived behavioural control (ability), which refers to a person’s degree of self-efficacy and anticipation of ease or difficulty in performing the behaviour.

In relation to the psychological influence of colour on humans, Mahnke believes that colour is part of the conscious, subconscious and unconscious experience, and that human reactions to colour are a result of not only psychological aspects but also physiological aspects of human behaviour and experience. From a design perspective, Meerwein et al. (2007) suggest three parameters of seeing, perceiving and experiencing colour, based on the spatial colour experience pyramid of Mahnke (1996), to explore the complex relationship between colour and people. In this model, which has much in common with Ajzen’s planned behaviour model, Mahnke identifies six factors that may affect an individual’s colour experience and uses these to explore the role of colour in the design process (Mahnke 1996) (Figure 2).

![Mahnke's colour experience pyramid](source: Mahnke 1996, p. 11)
The first level of the model is biological reactions to a colour stimulus as a result of human evolution. For example, the development of colour vision enables us to recognise ripe fruit and rotten vegetables. Colour vision is not just an optical tool for distinguishing between things but includes biological functions by carrying light and colour stimuli through the neural pathways to the brain, which has an impact on the production and release of hormones. This can explain changes in human physiological and psychological reactions when being confronted with different colours. The second recognised parameter is the collective unconscious. This archetype includes fundamental images, original patterns, experiences and stored knowledge from millions of years of development in our genetic map as a species. Conscious symbolism – associations – is the third level of the pyramid, and includes symbolism, impressions and associations on a conscious level such as the association of colours with natural features, which is common across different cultures, for example associating blue with the sky. The symbolism of colour and the meanings associated with it also play a significant role in religion, art, healing processes and philosophy.

The next two levels of the pyramid, cultural influences and mannerisms, and influences of trends, fashions, styles, are also related to colour symbolism and association. Therefore, an individual’s religion, culture and beliefs in addition to common trends and fashions can influence their colour experience, judgement and even attitude towards colour. A personal relationship with colours is the last level of Mahnke’s pyramid and includes personal characteristics, temper, physical and psychological constitution, age, gender and even personal experience. All these factors should be considered parameters that may influence our colour experience.

Thus, human responses to colour can be investigated based on three categories informed by Mahnke’s colour experience model and Ajzen’s theory of planned
behaviour: (1) colour and physiology, which includes colour vision ability, age, gender and personal characteristics; (2) colour and psychology, which includes all aspects of personal moods, attitudes, unconscious feelings and experiences, perceived control behaviour, and psychological and biological reactions; and (3) colour and cultural semiotics, which includes conscious symbolism, the collective unconscious, subjective norms and the influence of trends. The third category must, of course, include responses to colour informed our gendered cultural milieu.

**Colour, Physiology and Gender**

A person’s colour vision acuity is a fundamental factor affecting colour use and preference. It has been argued that human vision is able to distinguish between two and ten million different colours (Gouras 1991; Pointer & Attridge 1998). However, individual differences in human colour vision and visual disabilities such as different types of colour blindness, gender and age may all result in different colour perceptions. According to estimates by the Howard Hughes Medical Institute in 2006, approximately 7.0% of the male population and 0.4% of the female population suffer from colour vision disabilities, most of whom cannot differentiate red from green or perceive them differently to other people (Mandal 2014). Due to differences in emotional and physiological status, Bilmer et al. suggest that gender should also be considered an influential aspect in visual colour perception, preference and thus choice (Bimler, Kirkland & Jameson 2004b). Colour acuity is also influenced by ageing. Age-related physiological changes in the retina, thicker corneas, denser and more yellowish lenses, reduction in pupil size and changes in the visual nervous system all result in a gradual decline in visual function, quality and sensitivity to colour contrast (Ou et al. 2012; Pinheiro & Da Silva 2012).
Appendix A

Colour, Psychology and Gender

According to Lee and Lee (2006), human emotional responses to colour can be described as (1) unconscious (innate response); (2) semiconscious, which is achieved through learning and cultural or climatic factors; and/or (3) a conscious response known as preference, which can result from personal experiences, personality, fashion trends, contemporary culture and social semiotics. While the relationship between colour preference and attitudes to colour has been the subject of much study over a long period, the literature suggests that the relationship between use and preference is ‘bewildering, confused, and contradictory’ (McManus, Jones & Cottrell 1981). The literature also reveals a lack of agreement on the origins of colour preference. Some research suggests that colour preference is entirely a subject of personal taste, depending on individual associations and other subjective factors (Chandler 1934; McManus, Jones & Cottrell 1981). In contrast, other studies describe colour preference as an objective phenomenon partly depending on inherent stimulus properties (Granger 1952; Ou et al. 2004), which explains the universal preference for some colours such as blue. There is not, however, sufficient experimental evidence for either an extreme subjectivist and/or an objectivist point of view.

Cultural Semiotics and Gender

Eliot (1949) believes that for the survival and growth of culture, three conditions are needed: (1) transmission of culture to new generations; (2) cultural responses to regional context such as available sources and natural materials; and (3) balance of unity and diversity in religion. Accordingly, the influential aspects of culture on architects and architecture might be seen to be: (1) the strength of cultural transmission from previous generations to architects, which includes the role of the impact of attitudes to gender reflected by language systems and semiotics (2) the local
context and geography, and (3) the role of religion in the cultural indoctrination of architects. When investigating the impact of culture on design, it should be considered that culture is a dynamic system that is constantly changing and evolving in response to the altering outside world. Thus, in the realm of architecture, technological advances, the advent of new materials and techniques, and the influence of media are influential factors that not only shape the cultural system and needs of people but also inform new design approaches and attitudes.

Due to the robust relationship between colour and symbols (other than the influence of personal (unconscious), geographical and climatic (semi-conscious) conditions on colour attitudes), religious, cultural and social semiotics and norms (conscious symbolism) may modulate the individual designer’s colour preferences and attitudes towards colour use. Of course, all of these cultural influences shape and are shaped by perceived gender differences. Conscious symbolism and subjective norms refer to “the perceived social pressure to perform or not to perform the behaviour” (Ajzen 1991, p. 188). In this sense, individuals’ colour preference and choice may be influenced by the feelings and opinions of others (in the profession of architecture, this can be the public, clients and peers), including those informed by perceived gender differences. A study by Funk and Ndubisi (Funk & Ndubisi 2006) examined the influence of the salience of normative colour on marketing and product choice by consumers. For instance, meanings associated with the colour pink in Western cultures such as Britain not only make pink a marker of social identity – connected with femininity and related to qualities such as softness and delicacy – but also inform its use as a code for broader demographic categories of religion and gender (Koller 2008). In this sense, it is not only that colour itself acts as a group marker, but that sensitivity towards colour and colourfulness as such markers may influence individual colour preferences and attitudes towards colour use.
1.2 Gender Differences in Colour Preference

Colour preference might normally be understood as the tendency for an individual or a group to prefer some colours over others, such as having a favourite colour. Colour preference is theorised to depend on the situation/context of colour choice, the underlying associations that people may have developed (Grossman & Wisenblit 1999) and many other factors such as gender, age and emotional experiences.

As summarised by Khouw, (2012), the 21st century saw a number of studies finding evidence of gender differences in colour preferences. In early the 1940's Eysenck noted the following results in a review of studies into the relationship between gender and colour (Eysenck 1941). A study of St. George (1938) asserted that blue stands out more for men than for women. In similar studies, Dorcus (1926) found that yellow had a higher affective value for men than for women, Eysenck's own study found orange to be preferred over yellow by men, and yellow over orange by women, and Birren (1952) found men preferred orange to yellow while women identified orange as their least preferred colour.

Guilford and Smith (1959) found men tended to be more tolerant than women toward achromatic colours, and thus suggested that women might be more colour-conscious with more flexible and diverse colour tastes. McInnis and Shearer (1964) found that 56% of men and 76% of women preferred cool colours, and 51% men and 45% women preferred bright colours. They also found women preferred tints more than shades and favoured blue-green more than men did. Similarly, Plater (1967) found men largely preferred stronger chromas than women did.

Kuller (1976) investigated the physiological and psychological effects of colour in two opposite environments - one room colourful and complex and the other grey and sterile. He found that pulse rates for both sexes were faster in the grey room,
men were overall more stressed than women and more bored than women in the grey room.

Thomas, Curtis, and Bolton (1978) found a significant difference between men and women when they asked 72 Nepalese to list the names all the colours they could think of. Although the women consistently listed more colours, the cultural context of the research was identified as possibly explaining this finding because Nepalese women traditionally wear more colourful clothing. Similarly, when Greene (1995) asked college students to identify the colours of colour chips, it was found that women recognised significantly more colours than did the men and that these gender differences might be due to the different socialisation of men and women. Radeloff (1990) found that women were more likely than men to have a favourite colour and that women preferred soft colours while men preferred bright ones.

A number of more recent studies have not found any evidence for gender differences (Bimler, Kirkland & Jameson 2004a), others have suggested that colour perception and preference may be influenced by gender (Funk & Ndubisi 2006). When Hurlbert and Ling (2007) explored cross-cultural gender difference in colour preference, they found significant differences in the weights of the two fundamental neural dimensions that underlie colour coding in the human visual system. These dimensions are cone–opponent contrast components containing: (1) one achromatically opponent mechanism (light–dark (L+M); and (2) two chromatically opposing mechanisms (red-green (L-m cone) and blue-yellow (S–(L+M)) (Vincent et al. 2010). Hurlbert and Ling theorise that these differences may be linked to the evolution of gender-specific behavioural uses of trichromacy – the quality of having three independent channels for conveying colour information in the eye (2007). Despite the probability of innate difference between males and females in colour
preference, other factors such as cultural context, social semiotics and individual experience may also modulate colour preferences and attitudes.

To sum, the factors that may influence gender difference in colour preference and use can be categorised into four groups: (1) psychological differences relating to personal moods, attitudes, unconscious feelings and experiences, perceived control behaviour, and psychological and biological reactions; (2) physiological differences between males and females that impact colour vision; (3) cultural semiotics, including conscious symbolism, subjective norms, the influence of trends, and the collective unconscious, including the different socialization of men and women; and (4) individual attitudes towards colours, including personal characteristics, and individual experience – which might be influenced by our cultural-religious milieu.

2. Method

*Instrument and Participants*

Two equivalent surveys were prepared based on the findings of a pilot study: (1) an 85-item questionnaire for academics and professionals, and (2) a 79-item questioner for postgraduate architectural students. The survey was delivered online. Of the 274 completed questionnaires received, 62.77 percent of participants were professionals or academics and 37.23 percent postgraduate students. Gender distribution was fairly evenly split: 49.27 percent male, 48.91 percent female and 1.82 percent preferring not to say.

After a section establishing demographic information, the questions were divided into four categories: (1) *colour education*, (2) *culture and geography*, (3) *colour orientation* (colour attitude and preference) and (4) *practice*. The analyses presented in this paper are restricted to the three categories of *colour orientation* and *practice*. To investigate the relationship between colour knowledge, education,
orientation and colour use, included in the practice section were questions determining the colourfulness of designs and portfolios. The instrument made use of previous questionnaires where possible: Janssens and Mikellides’ (1998), Smith (2003) and Ural and Yilmazer (2010). While the organisational structure of the survey, and the questions used for testing colour knowledge, were informed by Janssens and Mikellides six-block survey, our survey has 8 blocks in three sections (as summarised in Table 1). In Block U-7, there are two questions from Ural and Yilmazer’s study (2010) that consist of 7 bipolar scales asking participants to describe their colour choice for the exterior and interior of two designs.

Table 4: The structure of final questionnaire

<table>
<thead>
<tr>
<th>Blocks</th>
<th>Specific content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section I</td>
<td>D-1 Demographic</td>
</tr>
<tr>
<td>Section II</td>
<td>P-A-2 Personal Colour Preference (P) and Attitude (A)</td>
</tr>
<tr>
<td></td>
<td>K-3 Colour Knowledge</td>
</tr>
<tr>
<td></td>
<td>E-4 Colour Education</td>
</tr>
<tr>
<td></td>
<td>P-5 Colour in Practice</td>
</tr>
<tr>
<td>Section III</td>
<td>U-6 Colour in Context</td>
</tr>
<tr>
<td></td>
<td>U-7 What informs your design colour choices?</td>
</tr>
<tr>
<td></td>
<td>P-8 General questions</td>
</tr>
</tbody>
</table>

Quantitative Analysis

Two categories of quantitative analysis were utilised to explore the relationships between the variables discussed in this paper: (1) parametric techniques, which are ideal for variables that meet the normality distribution assumption; and (2) non-parametric techniques, which are ideal for testing nominal (categorical), ordinal (ranked) scales and those types of data not meeting the normality assumption. In this
study one parametric technique used – the t-test, including independent, and paired sample t-tests; and one non-parametric technique – the chi-square and crosstab test.

The t-test compares the mean scores of two populations by looking at t-distribution and degrees of freedom to determine the probability of difference between populations. Two types of t-test were used: (1) the paired sample t-test or repeat measure, which used to investigate gender differences towards interior and exterior colour use in two case study designs (design 1 and 2); and (2) the independent sample t-test, which was used to determine gender differences in participants’ colour preferences and attitudes towards colour.

For these analyses, data in relation to five variables was collected: (1) architectural colourfulness preference, (2) perceived importance of colour to architecture, (3) general colourfulness preference, (4) colourfulness of design portfolio, and (5) specific colourfulness of Designs (1 + 2).

For testing the architectural colourfulness preference, participants were asked to rate their answer to two questions “what is your tendency towards colour use for interiors of building/ Exteriors of buildings?” from (1=colourless) to (7= colourful). Moreover, the following questions were used to achieve data for other nominated variables. For instance, to investigate the perceived importance of colour to architecture, participants were asked to rate their answers using 5-point Likert scales: (1) from 1 = Not at all to 5 = Very important to the question: “how important do you think the use of colour is in architecture?”. The general colourfulness preference of participants was tested through the following questions:

- Please rate your colour preference on a continuum: from 1 (colourless) to 7 (highly colourful);
- What is your favourite colour? Why?
- What is your least favourite colour? Why?
To investigate the level of colourfulness of participants’ portfolio, they were asked to rate their answers to the question: “How colourful would you say your portfolio of designs are?” from (1= colourless) to (7=colourful). Finally, the following two questions (Table 2) were asked to investigate specific colourfulness of Designs (1 + 2).

Table 5: Two questions from the survey related to variable "specific colourfulness of designs (1+2).

<table>
<thead>
<tr>
<th>How colourful was Design 1? (From colourless to very highly colourful)?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1=colourless</td>
</tr>
<tr>
<td>How colourful was Design 2? (From colourless to very highly colourful)?</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>1=colourless</td>
</tr>
</tbody>
</table>

Chi-square and crosstab, which is also called the one-sample chi-square test, is used to explore the relationship between non-parametric variables (categorical variables) and allows a comparison of the proportion of cases from a sample with hypothesised values or those obtained previously from a comparison population (Pallant 2016). Chi-square and crosstab were used in this study to explore the relationships between participants’ colour preferences (favourite and least favourite colours) and gender.

Qualitative Analysis

In addition to quantitative questions, the survey contains qualitative questions exploring the reasons behind architects’ colour choices. It contained two types of qualitative questions: open-ended questions and semantic differential questions (i.e. list of adjectives). The analysis of open-ended questions is based on the six-step grounded theory approach developed by Creswell (2009): (1) data preparation; (2)
Appendix A

obtaining general sense; (3) developing qualitative narrative via detailed analysis with coding process; (4) generating description (sorting data); (5) representing themes; and (6) interpretation and making meaning out of data. Thus, in this study, firstly the participants’ responses to open-ended questions were coded. Secondly, the transcripts were analysed to identify themes or patterns. Finally, emerging patterns and concepts from the data were explored for a deeper understanding of the factors that influence architects’ colour choices. In the semantic differential questions, informed by Smith’s (2003) study, participants are asked to describe the colour palette of their designs using 24 listed adjectives. For analysis of this type of data, NVivo software was used to investigate frequencies and patterns in participants' adjective choices. The same method was used to explore any relationships between gender and the selected adjectives.

3. Results

To test the impact of gender on colour attitude, preference and use, an independent-sample t-test was conducted to compare scores of colourfulness attitude, perceived importance of colour to architecture, general colourfulness preference, colourfulness of design portfolio, and specific colourfulness of Designs (1 + 2) for men and women. Colourfulness attitude scores are significantly higher for women (M=7.6, SD=2.2) compared to men (M=7.02, SD=2.13); t(267)=2.21, p=0.028, two-tailed. The mean difference in colourfulness attitude scores is 0.58 with a 95% CI ranging from 0.06 to 1.1. The eta squared statistic (0.018) indicates a very small effect size. However, results show significantly lower perceived importance of colour to architecture scores for women (M=0.13, SD=0.014) compared to men (M=0.18, SD=0.015); t(266)=−2.8, p=0.006, two-tailed, (mean difference = 0.6, 95% CI: −0.10 to −0.017) with a very small eta squared (0.028). Colourfulness preference scores are significantly higher for women (M=4.53, SD=1.57) than for men (M=4.04,
Appendix A

The mean difference in colourfulness preference scores is 0.49 with a 95% CI ranging from 0.121 to 0.866. The eta squared statistic (0.025) indicates a very small effect size.

Finally, colourfulness of design portfolio scores are significantly higher for women (M=4.28, SD=1.35) than for men (M=3.69, SD=1.27); t(117)=2.44, p=0.016, two-tailed. The mean difference in colourfulness of design portfolio scores is 0.59 with a 95% CI ranging from 0.11 to 1.06. The eta squared statistic (0.047) indicates a very small effect size. Although the results show significantly higher scores for women for the majority of the above variables, no difference was found between male and female scores for specific colourfulness of Designs (1+2).

To investigate cultural differences towards the interior and exterior colour use, participants were asked to describe their colour choice for the exteriors and interiors of the two case-study designs (Design-1 and Design-2) on 7 bipolar scales. Eight paired-sample t-tests were conducted to evaluate the difference between the use of colour from the interior to exterior space in relation to country of origin (culture) and gender (male/female). The first sets of analyses, four paired-sample t-tests, were conducted to compare male and female colour use for: (1) interior of Design-1; (2) interior of Design-2; (3) exterior of Design-1; and (4) exterior of Design-2.

Gender and interiors: The results show no significant difference between male and female scores for the 7 bipolar adjectives describing the interiors of Design-1 and Design-2.

Gender and exteriors: The results of paired-sample t-tests show that women chose significantly lower scores on the exciting/calming scale (M=3.93, SD=1.86) than men (M=4.63, SD=1.44); t(102)=−2.14, p=0.035, two-tailed, for exterior spaces in Design-1. The mean increase in exciting/calming scores is −0.695 with a 95% CI ranging from −1.34 to −0.051. The eta squared statistic (0.043) indicates a small
effect size. The analysis of scores for the 7 bipolar adjectives for exterior of Design-2 shows significantly higher scores for women on the harmonious/discordant (M=3.13, SD=1.62) compared to men (M=2.24, SD=1.5); t(71)=2.41, p=0.019, two-tailed, and on the pleasant/unpleasant scale (women M=3.00, SD=1.6; men M=2.17, SD=1.4; t(71)=2.35, p=0.021, two-tailed). The magnitude of the differences in the means for harmonious/discordant (mean difference = 0.881, 95% CI: 0.151 to 1.611) is moderate (eta squared = 0.075) and for pleasant/unpleasant (mean difference = 0.829, 95% CI: 0.128 to 1.53) is moderate (eta squared = 0.072).

To investigate the association between gender and colour preference, chi-square and crosstab tests have been used. A chi-square test for favourite colours indicates that favourite colour choice did not significantly differ between genders, X^2(9, n=252) = 8.12, p<0.522. The results of the crosstab test show that both genders tended to choose cold colours as their favourites (Figure 3).

![Figure 3: Male and female scores for favourite colours](image)

However, the results show that least favourite colour choice significantly differs between genders, X^2(10, n=219) = 19.91, p<0.030, Cramer’s V = 0.06. It also shows that both genders tended to choose warm colours as their least favourites (Figure 4).
Appendix A

Figure 4: Male and female scores for least favourite colours; left diagram: based on nominated hues; right diagram: based on warm and cold categories of nominated colours

The results of the comparison between participants’ answers to the appearance of any dominant colours in their designs reveal that, although both genders have higher scores for Yes, female architects (with 62.9%) are more likely to have a dominant colour or colour palette for their designs.

As many more answers were received for Design-1, to investigate the influence of gender on architects’ use of colour in their design, just the selected adjectives for Design-1 have been analysed. Although both genders have high scores for context sensitive, beautiful and successful, the results show a large difference between male and female descriptions of the colours they used. For instance, women have higher scores for user (score=27), client driven (score=23), innovative
Appendix A

(score=19) and cost-effective (score=17), while men have higher scores for other adjectives such as minimal (score=26), driven by personal taste (score=23) and functional (score=22). Interestingly, flamboyant (score=1) is the least chosen adjective by both genders. It is also interesting to see that climate sensitive, identified in the literature as an important influence on colour choice, received a low score by both men and women (Figure 5).

Figure 5: Difference between men and women in selecting from 24 adjectives for describing their use of colour in Design-1
4. Discussion

It was hypothesised that architects’ colour attitude, preference and use are influenced by their gender. It was found, using independent-sample t-tests comparing the scores of each gender, that female architects have significantly higher scores for colourfulness attitude, perceived importance of colour to architecture and colourfulness preference. It might also have been expected that female architects would have more colourful design portfolios. However, on the contrary, it has been found that male architects have significantly more colourful design portfolios. It might, therefore, be suggested that as female architects attach more importance to
colour use in their designs, then they are more cautious in comparison to male architects in their use of colour.

A further key finding in relation to colour orientation and gender is that the gender of architects influenced their attitudes towards colour for exteriors, as female architects preferred to use colours externally to create more exciting, vibrant and pleasant spaces in comparison to male architects. Thus, although women may use fewer colours in their designs, they may be more willing to choose colours that make their buildings stand out from the surrounding environment.

Finally, it was found that gender influenced architects’ colour orientation, colourfulness preference and colour (hue) choice and use. Therefore, it can be concluded that architects’ colour orientation, the colourfulness of their designs and their colour (hue) choice are influenced by their personal preferences, which have been formed during their childhood, design education and period of practising as an architect. However, having more colour knowledge and understanding can help architects to be more open to cultural influences.

Analysis of how architects described the colour palettes of two nominated designs using 24 adjectives indicated that architects described their colour use differently between designs. Despite some differences between adjectives chosen by different genders, the results also show interesting similarities; both genders most commonly described their colour palettes as beautiful, successful and context-sensitive, while flamboyance received the lowest scores from both genders. It might be concluded that although architects wish to be free to vary colour use between designs, the majority consistently aim to use quiet (not flamboyant) colours to create sensitive designs that consider context and users. Further research might usefully investigate whether users believe that architects consistently achieve these aims.
To elucidate the impact of gender on colour prejudices, architects were asked to nominate their favourite and least favourite colours. A significant association was found between favourite and least favourite colours using a chi-square and crosstab analysis. More specifically, there was a significant association between an architect’s gender and their least favourite colours. Interestingly, both genders preferred cold colours as their favourites and warm colours as their least favourites. The reasons for this can only be speculated on and indeed might be the focus of further research, but preference for cold colours is certainly consistent with avoidance of the colourful and reticence in using flamboyant colours – whether informed by insecurity, perhaps fear of criticism or lack of colour knowledge. As the use of bright and prime colours is often associated with child-focused environments, it might also be that warm and flamboyant colours are associated with naivety.

As gender appears to significantly impact designers’ use of colour in the built environment, it might be provocatively asked whether our cities would see more appropriate and considered the use of colour if more architects were female. Of course, our research only shows that females perceived their portfolios to be less colourful. Further research might investigate this in greater detail by analysing the colour content of actual designs, from sketching to built cases, where the impact of gender on colour attitude or preference within the contextual environment can be better determined. Further research might also investigate if less colourful is indeed a more considered design outcome, for this is clearly a contentious issue. Irrespective of the influence of gender, the findings clearly show that the individual preferences of designers impact their use of colour. While subjectivity is always going to influence design outcomes, the distinct lack of colour education in design education, particularly in architectural curricula, would suggest that colour use in architecture may have less theoretical underpinning and critique than other aspects of design.
A number of further study limitations are worth highlighting here. Firstly, interpretation of colour depends on factors other than gender that this study does not investigate, such as education and knowledge, the observer’s mental and physical condition, eyesight and design context. Nor has this study considered the place of colour consideration in the design process and thus has not looked at important questions such as when do architects choose the colour and the role of material choice in this decision process.

5. Conclusion
This paper set out to consider if the gender of an architect impact’s their use of colour in their designs. It was found overall that while female architects perceived colour to be more important to architecture than males did, females perceived their portfolios of designs to be significantly less colourful than the portfolios of their male counterparts.

It can be concluded from the results that: (1) although all architects wish to be free to vary colour use between designs, both genders consistently prefer to use quiet (not flamboyant) colours to create designs that are sensitive to context and users; (2) gender has an impact on architects’ colour preferences and choices when designing; (3) there is a significant relationship between gender and least favourite colour; (4) both genders see cold colours as their favourites and warm colours as their least favourites; (5) gender informs different attitudes towards interior and exterior colour use; (6) a recognition of the importance of colour to architectural design informs in female designers a more cautious and perhaps more considered approach to using colour.

These findings suggest that the colourfulness of an architect’s designs is influenced more by aspects of cultural indoctrination that influence personal colour
orientation – including gender and other aspects of cultural semiotics – than by design context. The research highlights the influence of the subjective and mostly unconscious influence of aspects of cultural indoctrination such as gender on architectural colour use. It is hoped that these findings might prompt educators to improve curriculum design and pedagogical approaches for teaching colour knowledge in ways that might see colour use become a more robust and defensible part of the design process rather than merely the result of designers’ personal preferences.

References


Boeri, C 2010, 'A perceptual approach to the urban colour reading', paper presented to Colour and Light in Architecture_First International Conference, Knemesi, Verona.


Eagly, AH & Chaiken, S 1993, The psychology of attitudes, Harcourt Brace Jovanovich, Fort Worth, TX.


Koller, V 2008, 'Not just a colour': pink as a gender and sexuality marker in visual communication', *visual communication, SAGE Publications*, vol. 7, no. 4, pp. 395-423.


Plater, G 1967, ' Adolescent preferences for fabric, color, and design on usual task', Indiana State College.


Smith, D 2003, 'Environmental colouration and/or the design process', *Color Research & Application*, vol. 28, no. 5, pp. 360-5.

St. George, MV 1938, 'Color preferences of college students with reference to chromatic pull', *learning, and association, ibid*, vol. 51.


COLOURFUL PRACTICE: IS DESIGN EDUCATION INFORMING ARCHITECTS’ USE OF COLOUR?

Bahareh Motamed and Richard Tucker, Deakin University

Submitted to International Journal of Technology and Design education

Abstract
This paper sets out to consider if design education informs architects’ colour use. Specifically, a survey of 274 architects, architectural academics and postgraduates in two countries of Australia and Iran addressed the questions; is design education informing colour knowledge, and does colour knowledge and design education inform architectural colour use? The findings suggest colour use in architecture has two chief influences: (1) Colourfulness Orientation (attitudes and prejudices towards colour use); and (2) Contextual Variables. The study shows that while the amount of colour education that architects receive has little role in informing their colourfulness orientations (i.e., how colourful they believe architecture in general should be), the greater an architect’s colour knowledge the more colourful their designs will be. The study suggests that the colourfulness of contemporary buildings is likely influenced more by architects’ personal preferences than by contextual influences such as the cultural and physical context of a design, the building function, or client directives.

Keywords:
Architectural design, design education, colour use, colour knowledge, decision making

Introduction
Despite the acknowledged cultural importance of colour, its role in architecture has historically been contentious. For while there have been periods and movements when architecture has reflected attempts through other cultural mediums to purge colour,
either by making it ‘foreign’ or by ‘relegating it to the realm of the superficial, the supplementary, the inessential, or the cosmetic’ (Batchelor 2000, p. 22), more recently the opposite has happened; new design-representation and building materials technologies have enabled contemporary buildings in cities to be saturated with colour. Here city colour palettes and identities have been transformed by juxtaposing or replacing vernacular colours with colours that are little informed by their cultural and physical contexts.

Recognising that architects’ colour selections have important cultural impacts prompts the wider question addressed by this paper: what informs architects’ colour choices in their designs? Surprisingly, this question has received very little research attention. For while colour and its use has been studied in multiple fields from many different perspectives, resulting in the recognition of a number of factors informing colour use – such as demographic characteristics (e.g. culture, age and gender), personal preference, and the potency and semiotic interpretation of symbols and meanings – only a small number of studies have attempted to find the variables impacting colour use and understanding in design, and fewer still have considered what informs architect’s colour choices. The paucity of research in this area has limited the scope of findings. Studies by Lenclos ((2004)) and Swiornoff (2000) have, for example, identified just geographical factors and cultural-religious distinctions in colour meanings as variables that may consciously or unconsciously inform designers’ colour selections and preferences.

As a relationship is likely between colour knowledge and colour use in practice, a small number of studies have looked at colour learning in architectural education. For instance, the studies of Kwallek and Stovall (2010), Vezzani ((2013)) and O’Connor ((2010)) have recognised lack of willingness to teach colour in architectural schools, relating this reluctance to communication problems and
teachers’ lack of colour knowledge. Similarly, Adams found in the majority of architectural curricula ignorance or lack of clarity about the role of colour as a significant design element and principal of architectural design (2013), and Ö. Gürel and Potthoff found that colour theory within the context of interior design was not being well addressed in architectural programs (Gürel & Potthoff 2006). Indeed, Minah concludes that ‘in schools of architecture and urban design, particularly in the United States, colour is rarely a subject of serious inquiry in the design studio’ (Minah 2012, p. 1). Similarly, our own survey of degree programs and course accreditation in Australia, UK and Iran has revealed a paucity of colour training in built environment education (Motamed, Tucker & Grose 2015). This prompts the question that is the specific focus of this paper; is design education informing architects’ colour knowledge, and does colour knowledge and colour education inform colour use in architecture? In answering these questions, this paper provides a critique of colour education and its role in informing effective and appropriate use of colour in the built environment? It is hoped that the findings of this study can inform improved curriculum design and pedagogical approaches for teaching colour knowledge in ways that see colour use become a more robust and defensible part of the design process.

To answer the wider question ‘what informs architects’ colour use?’, we have published elsewhere a theoretical framework hypothesising the relationship between the variables that might influence colour choice in building design ((Motamed & Tucker 2016). Figure 1 illustrates the two research stages that identified these variables. The first sought to identify all variables suggested by the literature across all domains of colour theory and research. In the second phase, these variables were refined via a pilot survey of architecture postgraduates, academics and practising architects based in Victoria, Australia. A final list of seven categories of variables was identified by analysis of quantitative pilot survey findings and (qualitative)
Appendix A

participants’ comments: (1) individual demographic characteristics (2) colour education, (3) colour knowledge, (4) culture, (5) colour preference, (6) colour attitude, and (7) design context (practice).

![Diagram](image)

This paper examines the relationship between colour use and four of these seven variables: (1) colour education, (2) colour knowledge, (3) colour (and colourfulness) preference, and (4) colour attitude. Here, two variables – colour preference and colour attitude – required clear delineation.

**Colour and Colourfulness Preference**

Colour preference might normally be understood as the tendency for an individual or a group to prefer some colours over others, such as having a favourited colour. Colour preference is theorised to depend on the situation/context of colour choice, the
underlying associations that people may have developed (Grossman & Wisenblit 1999) and many other factors such as gender, age and emotional experiences. A preference might also favour achromatic tones from white to black, and when it comes to a complex multi-component objects such as a building, preference might favour a more restricted colour palette over a highly colourful palette. Hence, in this paper we differentiate between colour preference and colourfulness preference – the latter being a measure of how colourful an architect’s design preferences are.

**Colour Attitude**

In general, *attitude* refers to a relatively enduring organisation of beliefs, feelings, and behavioural tendencies to respond positively or negatively towards a certain idea, object or situation (Hogg & Vaughan 2005). Thus, an individual’s attitude towards colour or a particular colour will affect the person’s choice of colour (Funk & Ndubisi 2006). According to the ABC model (Eagly & Chaiken 1993), attitude in general contains three components: (1) affective component, which is person’s emotions or feelings; (2) behavioural component, which is a person’s intended behaviour (positive or negative); (3) cognitive component, which is a person’s beliefs, values, or opinions held consciously. In this paper colour attitude refers to an architect’s beliefs and behavioural tendencies in relation to colour use in general in architecture and more specifically according to design context e.g., interior or exterior, at different stages of the design process, for different functions of buildings, for different locations, communicating contextually mediated meaning.

In the latter sections of this paper, we will also use the term *colour orientation* to signify a theoretical combination of colour preferences and attitudes i.e., all those preferences, beliefs and behavioural tendencies towards colour that an architect brings to every project and which varies little between projects. Thus, colour use in architecture is described in this paper as compromising two chief influences: (1)
Colour Orientation (which varies little if at all between designs); and (2) Contextual Variables (e.g. the cultural and physical context of a design, the building or building component function, client directives).

Before looking in detail at the literature on the variables examined in this paper, the notion of colour use in this study requires definition. Distinguishing between colour and colourfulness preference, we suggest two aspects of colour use in architectural design: (1) the colours that architects choose for a design, and (2) how colourful the design is. The differentiation is clear when we consider the portfolios of architects, for it is more common that an architect will be known for colourful buildings than for, say, red buildings. In this paper, we restrict our analysis to the second aspect – the colourfulness of designs. This restriction is dictated by the methodological limitations imposed by the range of use-variables that would be required to answer both questions i.e. what informs colourfulness, and what informs hue-choices across a range of designs. By restricting use only to colourfulness, analysis is possible that considers the relationship between the colourfulness of a range of designs and: (1) level of colour education, (2) level of colour knowledge, (3) colourfulness preference and (4) colour attitude. Thus, the precise research question considered in this paper is: does colour education and knowledge inform an architect’s colour orientation and the colourfulness of their designs? It will be shown that for architects there is statistically a clear relationship, as might be expected, between levels of colour education and levels of colour knowledge; a relationship between levels of colour knowledge and colour orientation; and a small but significant correlation between levels of colour knowledge and the colourfulness of their designs. There was, however, no direct significant relationships between levels of colour education and colour orientation or levels of colour education and the colourfulness of the architects’ designs.
1. Background

Here, we consider the literature across all fields on the three variables considered in this paper: Colour Orientation, Colour Knowledge and Education, and Colour Use.

1.1 Colour Orientation (preference-attitude)

According to Lee and Lee (2006), the human emotional responses to colour can be described as (1) unconscious (innate response); (2) semiconscious, which is achieved through learning and cultural or climatic factors; and/or (3) a conscious response known as preference, which can result from personal experiences, personality, fashion trends, contemporary culture and social semiotics. While the relationship between colour preference and attitudes to colour has been the subject of much study over a long period, the literature suggests that the relationship between use and preference is ‘bewildering, confused, and contradictory’ (McManus, Jones & Cottrell 1981). The literature also reveals a lack of agreement on the origins of colour preference. Some research suggests that colour preference is entirely a subject of personal taste, depending on individual associations and other subjective factors (Chandler 1934; McManus, Jones & Cottrell 1981). In contrast, other studies describe colour preference as an objective phenomenon partly depending on inherent stimulus properties (Granger 1952; Ou et al. 2004), which explains universal preference for some colours such as blue. There is not, however, sufficient experimental evidence for either an extreme subjectivist and or an objectivist point of view.

Sex difference is another factor that has been investigated in relation to colour preference. While some studies did not find any evidence for sex differences (Bimler, Kirkland & Jameson 2004a), others have suggested that colour perception and preference may be influenced by gender (Funk & Ndubisi 2006). Hurlbert and Ling
theorise that significant gender difference in the weights of the two fundamental neural
dimensions that underlie colour coding in the human visual system may be linked to
the evolution of sex-specific behavioural uses of trichromacy – the quality of having
three independent channels for conveying colour information in the eye (2007).
Despite the probability of innate difference between males and females in colour
preference, other factors such as cultural contexts, social semiotics and individual
experiences may also modulate colour preference.

1.2 Colour Knowledge and Architectural Education

Colour in education has been studied through different lenses in various disciplines,
such as neuroscience, psychology, linguistics, and education. Yet colour has rarely
been a subject of serious inquiry in design practice and education. The small number
of studies on colour learning and colour knowledge in architecture have considered
two broad aspects: curriculum and pedagogy.

1.2.1 Colour in Architectural Curricula

Batchelor (2000) argues that a lack of colour teaching in architectural curricula is a
consequence of chromophobia, which is rooted in a lack of confidence in or even fear
examined colour training in the curricula of Swedish and UK architecture
undergraduates, asking students what they knew ‘about perceptual and
psychophysiological aspects of colour, colour nomenclature, existing myths and
beliefs, and how colour is used in their everyday work in studios’ (Janssens &
Mikellides 1998, p.328). Despite the strong background of both countries in colour
research and colour system creation, a deficiency of colour knowledge was found, with
complaints from the cohorts ‘about a lack of coverage, of the subject area in lectures,
seminars, or studio work, with very little theory and only few practical exercises’ (Janssens & Mikellides 1998, p.328).

Minah has discussed the ethics of colour use (2013) in design practice in relation to how it is taught in the curricula of architectural institutes. In line with Durao (2012), he argues that colour in architecture education is presented as secondary to other architectural characteristics, and thus that professional architect’s lack of colour knowledge and the challenges they experienced bringing colour theory into practice to inform their colour use are a direct consequence of the relegated role of colour in their design education (Minah. G 1996).

1.2.2 Pedagogy in Architecture Colour education

A number of researchers have offered pedagogical solutions for improving colour knowledge in architecture. For instance, O’Connor (2010) believes that revising approaches to colour teaching, avoiding current ambiguity and confusion in colour theory and colour knowledge communication, and absorption of colour theories from other knowledge domains can improve the willingness of architectural schools to teach colour. Kwallek and Stovall (2010) designed an interdisciplinary model for teaching colour to undergraduate architecture students that seeks to increase student awareness of their professional responsibility for the impacts of their colour choice on society (Kwallek. N & Stovall. L 2010). Finally, Vezzani suggests a toolkit to support colour knowledge through three stages of design learning: (1) personal investigation and research, (2) starting dialogue and finding common language with other disciplines and (3) organising information through design. Although these handful of studies have advanced pedagogies for improving colour teaching in design curricula, none have considered if design education is informing colour use in practice.

1.3 Colour Use
The literature on the use of colour in art and architecture dates back to antique times, and can be traced from Vitruvius to the Renaissance treatises. Vitruvius discussed in Book 7 of the Ten Books of Architecture (\textit{De architectura} (20 B.C.)) the pragmatics of sourcing natural colours and of creating artificial colours, but said little about what might inform colour choice beyond these practical limitations. Alberti (Chapter 10 of book 7 \textit{On the Art of Building in Ten Books (De re aedificatoria)} (1485)), argues for purity and simplicity when colour is used for decoration and adorning walls, and in \textit{On Painting (De picture)} referred to the affective and emotional values of colour. Palladio, in \textit{The Four Books of Architecture (I Quattro Libri dell Architettura)} (1570), discusses colour as one of the features of materials that ought to be considered before starting to build in order to create a beauty in correspondence with the form as a whole (book1, chapter 22), but in his fourth book advises that painting sacred place such as temples would be improper as this would detract from their magnificence.

Whilst there has been much contemporary research in the realms of health and wellbeing on the psychological influence of colour in buildings on feelings, moods and behaviour (Birren 1978; Elliot et al. 2007; Withrow 2004; Yu & Yoon 2010), a relatively small number of studies have looked at colour use in design. For instance, when Smith (2003) investigated how important colour was for interior designers and architects, she found five factors that may affect the choice of colour by architects: organisational and/or personal colour preference and style, context, building typology, end-user preferences, and innovation. Minah highlighted the role of colour as integral to design, finding colour use in three phases of the design process: (1) colour dynamics in the conceptual phase i.e., using colour as a communication tool in conceptual drawings to clarify concept; (2) colour tectonics in the schematic/form-making to help in understanding the design, its relation to context and selecting potential materials; and (3) colour imagery in the design development phase. Minah also discusses the use
of colour as a tool for recording the experience of space as well as for showing physical space through techniques such as cognitive maps. Finally, Serra (2013) categorized into three main groups the strategies of environmental designers for using colour: (1) to influence the perception of the visual properties of architectural shapes; (2) to describe the building; (3) use of colour based on its intrinsic value.

2. Method

In the first phase of the research, a pilot study tested the viability of a questionnaire distributed amongst two small groups of participants in Victoria, Australia: (1) postgraduate higher-degree-by-research architectural students (HDRs), and (2) academics and practising architects. The analysis of data from the pilot, published elsewhere (Motamed, Tucker & Grose 2015), reveals an absence of sufficient and thorough education on colour, but general agreement on the importance of colour in architectural design.

In the second phase, which is the focus of this paper, two surveys were prepared based on the findings of the pilot: (1) an 85-item questionnaire for academics and professionals, and (2) a 79-item questioner for postgraduate architectural students. To investigate the role of culture, both surveys were distributed in Iran and Australia. The survey was delivered online. Of the 274 completed questionnaires received, 44.16 percent were from Iran and the rest from Australia. 62.77 percent of participants were professionals and academics and 37.23 percent postgraduate students. Gender distribution was fairly evenly split: 49.27 percent male, 48.91 percent female and 1.82 percent preferring not to say.

The questions were divided into four categories: (1) colour education, (2) culture and geography, (3) colour orientation (colour attitude and preference) and (4) practice. The analyses presented in this paper are restricted to the three categories of
colour education, colour orientation and practice. To investigate the relationship between colour knowledge, education, orientation and colour use, included in the practice section were questions determining the colourfulness of designs and portfolios. The instrument made use of previous questionnaires where possible: Janssens and Mikellides’ (1998), Smith (2003) and Ural and Yilmazer (2010). While the organisational structure of the survey, and the questions used for testing colour knowledge, were informed by Janssens and Mikellides six-block survey, our survey has 8 blocks in three sections (as summarized in Table 1). In Block U-7, there are two questions from Ural and Yilmazer’s study (2010) that consist of 7 bipolar scales asking participants to describe their colour choice for the exterior and interior of two designs.

Table 6: The structure of final questionnaire

<table>
<thead>
<tr>
<th>Blocks</th>
<th>Specific content</th>
</tr>
</thead>
<tbody>
<tr>
<td>D-1</td>
<td>Demographic</td>
</tr>
<tr>
<td>P-A-2</td>
<td>Personal Colour Preference (P) and Attitude (A)</td>
</tr>
<tr>
<td>K-3</td>
<td>Colour Knowledge</td>
</tr>
<tr>
<td>E-4</td>
<td>Colour Education</td>
</tr>
<tr>
<td>P-5</td>
<td>Colour in Practice</td>
</tr>
<tr>
<td>U-6</td>
<td>Colour in Context</td>
</tr>
<tr>
<td>U-7</td>
<td>What informs your design colour choices?</td>
</tr>
<tr>
<td>P-8</td>
<td>General questions</td>
</tr>
</tbody>
</table>

To investigate the influence of colour education, participants were asked to rate on a 5-point Likert scale their level of agreement with three statements about: (1) how much higher education they received on colour theory, (2) how much higher education they received on using colour when designing, (3) how much their higher
education impacted their use of colour when designing. The questions aimed to
differentiate between learning about colour theory and colour use in practice.

The Oxford dictionary defines knowledge as someone’s awareness or
familiarity acquired through experience or education. Thus, twenty questions were
designed to measuring colour knowledge by combing actual knowledge with

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Minimal</td>
<td>Below average</td>
<td>Average</td>
<td>Above average</td>
<td>Expert</td>
</tr>
</tbody>
</table>

K.1.1 Please self-rate your knowledge and familiarity with the words below; from 1-6 (please do not augment your existing knowledge by looking up these terms. It is important that we determine your present knowledge.)

Figure 2: The preview of first set of 10 questions to be self-rated by participants in based on their colour knowledge. Source: final survey.

The next 10 questions (Figure 3), informed by the Janssens and Mikellides (1998), were on colour theory understanding and were used to measure actual colour knowledge. To arrive at one score from the two scales, the following process was used: (1) summing up the scores of the 10 self-rated colour knowledge questions (score-range 10-60); (2) for the next 10-question block, the score of each question has been calculated individually and then total scores summed, e.g. for question K.1.2.1, participants can select 4 right answers from the 6 offered, while for question 1.2.4 there is only one right answer (thus, the maximum score for the second 10 series of questions
(3) finally, the score of both series of 10 questions is summed (so the maximum achievable score is 82).

| K.1.2.1 Do you know what ‘CMYK’ stands for (select all that apply)? |
| K.1.2.2 The after-image of the colour Red (in white background) is (select all that apply)? |
| K.1.2.3 The primary colours of light (additive colours) are (select all that apply) |
| K.1.2.4 Which of the following five colours has the highest visual strength? |
| K.1.2.5 Select the colours that correspond to the subtractive colour primaries (select all that apply) |
| K.1.2.6 Select the colour that corresponds to digital representation: R=255, G=0, B=0. |
| K.1.2.7 Select the colour that corresponds to the digital representation: R=255, G=255, B=0. |
| K.1.2.8 A “Magenta” surface is one which |
| K.1.2.9 What is the Pantone series of colours used for (select all that apply)? |
| K.1.2.10 What distinguishes the Natural Colour System from other systems (select all that apply)? |

Figure 3: The next 10 detailed questions about colour knowledge. Source: final survey.

To determine attitudes towards colour use, participants were asked to rate on a 5-point Likert scale their perceived importance of colour to architecture. To determine colourfulness preferences, participants rated (from 1 (colourless) to 7 (colourful)) three contexts of colour use: (1) architecture in general, (2) interiors in general, (3) exteriors in general. To determine colour use, participants rated (from 1 (colourless) to 7 (colourful)) the colourfulness of: (1) their portfolio of designs, and (2) two of their own recent designs.

A series of statistical analyses were conducted to explore the relationship between colour education, knowledge, attitude, preference and use. Two types of
statistical tests were used: multiple regression and Pearson correlation. Multiple regression is commonly used to explore the predictive relationship between one continuous dependent variable and a number of independent variables. It also considers the relationship between all the predictive variables as a whole (the model), and the relative contribution of each predictive variable to the model.

Multiple regression was used to evaluate the power of Education and Colour Orientation in predicting architects’ colour use. In order to meet the assumptions of multiple regression analysis, preliminary analysis was conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity.

To investigate the relationship between Colour Knowledge and the colourfulness of the participant’s design portfolios, Pearson correlation was used. Pearson correlation coefficients not only describe the strength of the relationship between variables but also show the direction of their linear relationship.
3. Results

The following section reports the analyses of participants’ answers to the twenty-three questions listed above (Figure 4).\(^1\)

3.1 Education

It is hypothesised that the educational background of an architect impacts their colour understanding and their attitude to colour use when designing, but not their colourfulness preference or actual colour use (colourfulness of designs). To test this hypothesis, seven individual multiple regression analyses were conducted to investigate the power of (1) E1-Thoroughness of Colour Theory Education, and (2) E2-Thoroughness of Colour Practice Education, in predicting seven dependent variables in four categories (Figure 5): (1) K1-Colour Knowledge (including perceived impact of education on colour knowledge); (2) A1-2 Colour Attitude (containing architectural colourfulness preference and perceived importance of colour to architects), (3) P1-Colourfulness Preference (including general

---

\(^1\) Note that Colour Knowledge shifts between an independent and dependent variable based on the specific analysis used.
colourfulness preference; (4) U1-2 Colour Use (including colourfulness of design portfolio and specific colourfulness of two designs (Figure 5).

It was found that the two-variable model of Thoroughness of Colour Education (Theory and Practice) did significantly predict architects’ Perceived Importance of Colour to Architecture, accounting for 3.2 percent of the variance, F(2, 161) = 3.72, p < .001; while neither predictor had significant part effects in the full model. It was found that the two-variable model significantly predicted Perceived Impact of Education on Colour Knowledge in the model, accounting for 29.9 percent of the variance, F(2, 159) = 33.835, p < .001, with Theory education accounting for the greatest variance. It also reveals that from the two-variable model, only Colour Theory education could significantly predict Colour Knowledge in the model.
Moreover, it was found that the two-variable model did not significantly predicted 
Architectural Colourfulness Preference, General Colourfulness Preference, 
Colourfulness of Design Portfolio and Specific Colourfulness of Designs.

3.2 Colour knowledge

It is hypothesised that the level of an architect’s Colour Knowledge will predict the 
colourfulness of their designs. The relationship between Colour Knowledge, Specific 
Colourfulness of Designs and Colourfulness of Design Portfolio was investigated 
using Pearson product-moment correlation coefficient. Preliminary analyses were 
performed to ensure no violation of the assumptions of normality, linearity and 
homoscedasticity.

There were significant, positive correlations between Colourfulness of Design 
Portfolio and Specific Colourfulness of Designs (medium correlation, \( r = .316, n = 109, 
\ p < .001 \)).

Moreover, there were significant, positive correlations between Colourfulness of 
Design Portfolio and Colour Knowledge (small correlation, \( r = .272, n = 109, p < .005 \) 
(Table 2).

\[
\begin{array}{c|c|c|c}
\text{Specific Colourfulness of designs} & \text{Colour Knowledge} & \text{Colourfulness of Design Portfolio} \\
\hline
\text{Pearson Correlation} & 1 & .140 & .316** \\
\text{Sig. (2-tailed)} & .148 & .001 \\
\hline
\text{Colour Knowledge} & \text{Pearson Correlation} & .140 & 1 & .272** \\
\text{Sig. (2-tailed)} & .148 & .004 \\
\hline
\text{Colourfulness of Design Portfolio} & \text{Pearson Correlation} & .316** & .272** & 1 \\
\text{Sig. (2-tailed)} & .001 & .004 \\
\end{array}
\]

**. Correlation is significant at the 0.01 level (2-tailed).
Appendix A

3.3 Colour orientation

The two variables of Colour Preference and Colour Attitude, indicating colour orientation, were used in a 2-variable model to predict colour use. Thus, multiple linear regression analysis was used to develop a model for predicting Colourfulness of Design Portfolio scores and Specific Colourfulness of Designs (1+2) scores from their Architectural Colourfulness Preference scores, and General Colourfulness Preference scores. Preliminary analysis was conducted to ensure no violation of the assumptions of normality, linearity, multicollinearity and homoscedasticity. Each of the predictor variables had a significant (p < .001) zero-order correlation with both dependent variables. Using the enter method it was found that Architectural Colourfulness Preference and General Colourfulness Preference Colour can significantly predict actual Colourfulness of Design Portfolio scores and Specific Colourfulness of Designs (1+2) scores. In model-1 (Table 3), the two-variable predictor model was able to account for 27.6 percent of the variance in Colourfulness of Design Portfolio, F (2, 114) = 21.744, p < .001. Of these two variables, neither predictor had significant partial effects in the full model, with Colourfulness Preference accounting for 2.69 percent of the variance, and General Colourfulness Preference accounting for 0.85 percent of the variance. In the second model (Table 3) the two-predictor model was able to account for 11 percent of the variance in Specific Colourfulness of Design (1+2), F (2, 129) = 8.02, p < .001. Of these two variables, General Colourfulness Preference makes the largest unique contribution (beta= .252, t (132) = 2.45), although Architectural Colourfulness Preference also made a statistically significant contribution (beta= .332), but only General Colourfulness Preference had significant part effects in the full model, accounting for 4.12 percent of the variance.
4. Discussion

*Impact of Colour Education*

Two key but perhaps predictable findings from the analyses were that the levels of colour education architects received significantly predicted: (1) their colour knowledge; and (2) how much they thought their education had informed their colour knowledge. Levels of colour education, specifically on colour theory, also significantly predicted how important to architectural design architects perceived that colour was. This latter finding is an important one for educators, for it might be said to imply that architects’ will be more considered in their use of colour when better educated about colour theory. However, while the link between education and colour knowledge was strong, levels of colour education had little impact on architects’ general attitudes to how colourful buildings should be or, consistent with this finding, how colourful architects’ portfolios were or how colourful two of their most recent designs were.
It was expected that architects would be freer in their use of colour when they had higher levels of colour knowledge, and it was found that there was indeed a significant correlation between colour knowledge and the colourfulness of architect’s design portfolios. Thus, the more colour knowledge that architects had the more colourful were their design portfolios. Thus, it might be interpreted that a lack of knowledge leads to a reluctance to use colour, perhaps because of a fear of using it inappropriately.

It was also found that the general preferences that architects expressed for how colourful they felt buildings, interiors and exteriors should be significantly predicted how colourful their portfolios were and also how colourful two of their recent designs were. Thus, an architect’s colourfulness orientation clearly impacts how colourful their buildings are. Or in other words, the opinions and preferences, or what might even be called prejudices, an architect brings to all projects about how colourful buildings should be inform how colourful their designs will be – irrespective of the contexts of these designs. This finding is reinforced by the significant correlation between the colourfulness of the architects’ design portfolios and the colourfulness of two of their most recent designs; meaning the colourfulness of specific designs are consistent with the colourfulness of architects’ designs over their careers. This is perhaps the most noteworthy finding of our study, for it confirms (but refines) the theory put forward at the beginning of this paper, namely that colour use in architecture has two chief influences: (1) Colourfulness Orientation (which varies little if at all between designs); and (2) Contextual Variables (e.g. the cultural and physical context of a design, the building or building component function, client directives). Although it might be speculated, based on our data, that context might have a greater role in informing colour (hue) choice than in informing the colourfulness of buildings. Our findings also suggest the possibility that what might be considered important contextual influences
on architectural colour use – such as client preference, building function and use, the cultural/historical context of a design, and the physical context such as neighbouring buildings and natural features – may be subservient to an architects’ preferences and prejudices towards colour use. The consequences of such a possibility are important, and thus the relationship between architects’ colour preferences and the influence of context on design is worthy of further research. The finding also raises an additional question worthy of research – if architects’ colourfulness orientations and colour prejudices are not informed by their education, what are they informed by? It might be speculated that if education does not inform orientations towards colour use, then these orientations might be pre-formed by socio-cultural-religious influences before an architect is educated. And indeed research (see, for instance, Lee and Lee (2006)) has shown that preferences in relation to colour are indeed informed by such influences, such as personal experiences, personality, fashion trends, contemporary culture and social semiotics. Indeed, it is an aim of our study to further investigate this question.

A number of study limitations are worth highlighting here that might be considered in future research. Firstly, interpretation of colour depends on factors other than education and training that this study does not investigate, such as cultural indoctrination, the observer’s mental and physical condition, eyesight, colour preferences and design context. Nor has this study considered the place of colour consideration in the design process, and thus has not considered important questions such when architects choose colour and the role of material choice in this decision process.

Although in some projects the context and function of the building have greater influence on the use of colour due to the perceived requirements of its users i.e. in the design of elementary schools and kindergartens, it has also been found that the colour use of architects appears to be influenced more by their personal colour orientation
and cultural indoctrination than by design context and educational and theoretical knowledge. It may even be likely that when architects are designing buildings such as hospitals and kindergartens where there is a wealth of knowledge on the importance of colour choice, their colour choices may be highly influenced by their own colour orientation and level of colour knowledge. This is a question that might usefully form the subject of future research.

5. Conclusion

This paper set out to critique architectural colour education by considering the role of colour knowledge in informing architects’ colour choices. Specifically, the study addressed the questions; is design education informing architects’ colour knowledge, and does colour knowledge and colour education inform colour use in architecture? Through the survey of 274 architects, architectural academics and postgraduates studying architecture, it was found that for these participants there was a clear relationship between levels of colour education and levels of colour knowledge, some relationship between levels of colour knowledge and colour orientation, no relationship between levels of colour education and the colourfulness of designs, and a small but significant correlation between levels of colour knowledge and the colourfulness of designs. The findings suggest that colour use in architecture has two chief influences: (1) Colourfulness Orientation (architects’ attitudes and prejudices towards colour use, which vary little if at all between designs); and (2) Contextual Variables (specific to each design, but which might have a greater role in informing colour choices than the colourfulness of designs). The study shows that how colourful our contemporary buildings are is likely influenced more by an architect’s personal preferences than by the contextual variables of designs – such as client requirements, building function and use, the cultural/historical context of a design, and physical context such as neighbouring buildings and natural features.
Based on the finding of this paper and the framework we have posited elsewhere of the influential factors on architect’s colour use, educationalist might reconsider re-examining the place of colour teaching in architectural and urban design curricula so that colour use become a more robust and defensible part of the design process rather than merely the result of a designer’s individual preferences. The findings also suggest that colour theory becomes divorced from its practical use if basic colour knowledge is taught without a sense of the impact of colour on design outcomes, the possible roles of colour in the design process, and the different considerations that should inform colour use.

Reference


Batchelor, D 2000, Chromophobia, Reaktion books.


Birren, F 1978, Colour Psychology and Color Therapy; Historical, Biological, Psychological and Visual Aspects of Colour, Van Reinhold Company Inc, New York, USA.

Boeri, C 2010, 'A perceptual approach to the urban colour reading', paper presented to Colour and Light in Architecture_First International Conference, Knemesi, Verona.


Eagly, AH & Chaiken, S 1993, *The psychology of attitudes*, Harcourt Brace Jovanovich, Fort Worth, TX.


Koller, V 2008, 'Not just a colour': pink as a gender and sexuality marker in visual communication', *visual communication, SAGE Publications*, vol. 7, no. 4, pp. 395-423.


Appendix A


Plater, G 1967, 'Adolescent preferences for fabric, color, and design on usual task', Indiana State College.


Smith, D 2003, 'Environmental colouration and/or the design process', Color Research & Application, vol. 28, no. 5, pp. 360-5.
St. George, MV 1938, 'Color preferences of college students with reference to chromatic pull', *learning, and association, ibid*, vol. 51.


COLOURFUL LANGUAGE: RESEARCHING ARCHITECTS’ KNOWLEDGE AND USE OF COLOUR

Bahareh Motamed1, Richard Tucker2 and Margaret Grose3, 1,2 Deakin University, Geelong, Australia, 3 University of Melbourne, Melbourne, Australia


Abstract:

The development of architectural materials and technology is transforming the colour palettes and identities of cities by juxtaposing or replacing vernacular colours with global and often contextually meaningless colours. As Built Environment designers have significant roles in determining city colourscape, it might be expected that these professionals have considerable knowledge. However, there is largely an absence of colour training in the majority of built environment degree programs. While colour has been studied in a broad range of disciplines, very few studies have focussed on architecture and even less on colour in architectural education. This paper reports on the early findings of research into what informs architect’s understanding and use of colour. Data was analysed from a survey of 33 practicing architects, academics and postgraduate students from Melbourne, Australia. The findings indicate that built environment designers see the need for increasing their colour knowledge. In line with previous studies, there was no evidence of correlations between gender and age, but findings suggest cultural differences in the level of colour education depending on country of architectural study. The wider research that this study is a part of ultimately aims to inform education around the use of colour in the built environment.

Keywords: Colour; colourscape, architectural education.
LEARNING A COLOURFUL LANGUAGE: INVESTIGATING COLOUR IN
ARCHITECTURAL EDUCATION

Bahareh Motamed1, Richard Tucker2 and Margaret Grose3, 1,2 Deakin University,
Geelong, Australia, 3 University of Melbourne, Melbourne, Australia

Australia Council of University Art and Design Schools conference proceedings, Adelaide,
2015

ABSTRACT
Colour is able to connect the realms of architecture, history and culture through its impact on feelings, interpretations and perceptions. It also plays a prominent role in the visual hierarchy of urban space, where it can emphasize or disrupt unity. Commonly, the development of architectural and IT technology, together with the march of globalization, has transformed the colourscapes of contemporary cities to become contextually meaningless and without respect to urban cultural identity. In light of the impact of the built environment on city colourscape, and thus the wellbeing of city dwellers, it can be argued that those responsible for colour decisions making should have considerable knowledge and experience in use of colour. However, a review of literature and the curricula of Australian architectural schools reveal a lack of colour training leading to low confidence amongst many architects to use colour. Thus, this study investigates the relationship between colour learning in architectural education and colour use in architectural practice. Data was collected by means of a survey of postgraduate students and architectural practitioners in Victoria, Australia. The findings reveal a lack of learning about colour in architectural education, despite overwhelming agreement about the importance of colour knowledge to practice.

Key words: Colour; City colourscape; Architectural Education
COLOUR KNOWLEDGE IN ARCHITECTURAL EDUCATION: TO WHAT EXTENT DOES DESIGN EDUCATION INFORM ARCHITECTURAL COLOUR USE?

Bahareh Motamed1, and Richard Tucker2

1,2 Deakin University, Geelong, Australia, 3 University of Melbourne, Melbourne, Australia

Global Education Conference, University of Riverside, CA, USA, 2017

Abstract

Today, as in the past, colour can be interpreted as representative of semiotic recognition, belonging, and qualities of the city related to place-identity. However, the development of architectural materials and technology is transforming the colour palettes and identities of cities by juxtaposing or replacing vernacular colours with global and often contextually meaningless colours. This erosion of visual culture can disenfranchise inhabitants from their cities and impact their quality of life. As architects have significant roles in determining the appearance of the buildings that contribute to city colourescapes, it might be presumed that colour has a significant place in the education of architects and urban designers. However, colour has been dropped from the core curricula of the majority of architectural schools, meaning architects are likely making colour choices based on practical rather than theoretical knowledge. This prompts the question that is the main focus of this paper: how much does design education inform architect’s colour choices? To answer this question a mixed methods approach was adopted using qualitative and quantitative data collection and analysis techniques both in parallel and sequentially. Data were collected through circulation of an international survey amongst architectural students, academic and practicing architects in Australia and Iran. Although the results show overwhelming agreement on the central importance of colour in
architectural design, the study shows that education has little role at present in informing architects’ colour orientations or their use of colour when designing.

Keywords: Colour knowledge, architectural education, colour use.
APPENDIX B:
QUESTIONNAIRES
APPENDIX B – QUESTIONNAIRE

FINAL SURVEY FOR PROFESSIONAL AND ACADEMIC

Survey: PROFESSIONAL & ACADEMIC EXPERIENCES IN RELATION TO THE USE OF COLOUR IN THE BUILT ENVIRONMENT

The following survey instrument is part of a wider project being investigated by PhD candidate Bahareh Motamed from the School of Architecture and Built Environment at Deakin University, under the supervision of Associate Professor Richard Tucker and Senior Lecturer Margaret Grove.

The survey aims to investigate the impact of architects’ personal and educational backgrounds on their understanding and use of colour. The survey aims to elicit answers to three main questions: (1) how much do architects know about the theory and use of colour? (2) how do architects make colour choices? and (3) what influence does education have on an architect’s use and understanding of colour?

The ultimate aim of this project is to inform curricula renewal around colour knowledge and use in architectural education.

Once you have completed the survey, the hypotheses that we are seeking to answer will be explained to you.

On behalf of the team, Associate Professor Richard Tucker and Senior Lecturer Margaret Grove would like to thank you for your contribution to this project. If you have any questions, or require further assistance in filling this survey, please do not hesitate to contact Bahareh Motamed at bmotame@deakin.edu.au

Plain Language Statement

TO: the Practitioner and Academic completing the survey “PROFESSIONAL & ACADEMIC EXPERIENCES IN RELATION TO THE USE OF COLOUR IN THE BUILT ENVIRONMENT.”

Full Project Title: Investigation of what informs architect’s colour choices in their design
Principle Researcher: Associate Professor Dr Richard Tucker
Student Researcher: Bahareh Motamed
Associate Researcher(s): Dr Margaret Grove

This survey instrument is part of a wider project being investigated by PhD candidate Bahareh Motamed from the School of Architecture and Built Environment at Deakin University, under the supervision of Associate Professor Richard Tucker and Senior Lecturer Margaret Grove.

This project investigates how much your personal and educational experiences have informed your understanding and use of colour in architecture. It aims ultimately to improve understanding and education around the use of colour in the built environment in Australia. You are invited to complete the online survey “PROFESSIONAL & ACADEMIC EXPERIENCES IN RELATION TO THE USE OF COLOUR IN THE BUILT ENVIRONMENT.” The survey includes questions about the understanding and use of colour by designers and academics and the role of colour study in architectural education.

The study ultimately aims to enhance teaching and learning in architecture and built environment programs by improving education in colour use and understanding. Your comments will remain anonymous throughout the PhD thesis, different reports and publications developed out of this study. The overall time required for completing the survey is around 15-35 minutes. Accepting and answering implies your consent for the use of your information in the research. Your participation is voluntary and your participation (or not) will not have any effect on your relationship with your employer or any relationship with Deakin University. No personal information has been supplied to the researcher or Deakin University. However, if you feel uncomfortable answering any questions, you can withdraw from the survey at any time up until the survey is submitted. After submission it is not possible to withdraw your information as the survey is anonymous and cannot be tracked back.

There is no risk involved for participants. Participation in this survey may be beneficial for architects who wish to express their views on the place and importance of colour in architectural education. The feedback in this study may inform future guidelines for improving built environment education and curriculum.
All data downloaded from the online questionnaire will be stored on a password-protected server at Deakin University for at least a period of 5 years after the final publication of the research outcomes. The data will also be stored on archival storage media that will be kept securely in the principal investigator's locked cabinet at Deakin University, Geelong Waterfront Campus, for a period of at least 5 years after the final publication of the research outcomes. If you wish to access the results of the survey, or require further clarification regarding the survey and its procedures, you can contact Baharsh Motamed (contact details at the end of this form).

Approval to undertake this project has been given by the Human Ethics Advisory Group (HEAG), Faculty of Science Engineering and Built Environment, Deakin University.

If you have any complaints about any aspect of the project, the way it is being conducted or any questions about your rights as a research participant, then you may contact:
The Manager, Ethics and Human, Deakin University, 221 Burwood Highway, Burwood Victoria 3125, Telephone: 9251 7129, Fax number: 9244 6888; research-ethics@deakin.edu.au Please quote project number: STEC-30-2015-MOTAMED.

BAHARSH MOTAMED
PhD Student
School of Architecture and Built Environment
Deakin University
Email: bmotamed@deakin.edu.au
Mobile: 0408177904

I have read and understand the attached Plain Language Statement. I freely agree to participate in this project according to the conditions in the Plain Language Statement. I have been given a copy of the Plain Language Statement and Consent Form to keep. The researcher has agreed not to record any identity and personal details, including where information about this project is published, or presented to any public forum.

☐ I Agree

Block I: Demographics

1.1 Are you?
- Male
- Female
- Prefer not to say

1.2 What is your age range?
- Under 22
- 22-30
- 31-40
- 41-50
- Over 50

1.3 Highest completed design degree:
- Bachelor
- Master
- PhD

1.4 What year did you graduate from your most recently completed design degree?
1.5 Occupation:  
- Student  
- Architect in practice  
- Urban designer in practice  
- Academic  
- Other [ ]

1.6 In which city do you currently practise or study?  

1.7 In which country did you spend the majority of your childhood?  

1.8 In which country did you receive each of the following degrees?  
   - 1st undergraduate degree  
   - 2nd undergraduate degree  
   - Postgraduate degree  

1.9 Colour has an important role in the cultural traditions of my home-country.  

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>●</td>
<td>●</td>
<td></td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>

1.10 Tell us about any colour biases in the visual culture of your home country, and how this is reflected (at all) in the built environment?  

Block II: Personal Colour preference and attitude

This question is about your preference for the colourful or colourless. Some of us shy away from colour in our man-made environments, preferring
Appendix B: Questionnaire

the colourless (black, white or greys) or perhaps monochromatic schemes (shades of the same hue), or a small number of hues. While some of us enjoy highly colourful environments.

2.1 Please rate your colour preference on a continuum: from 1 (colourless) to 7 (colourful)
   (Select)

2.2 What is your favorite colour? Why?

2.3 What is your least favorite colour? Why?

2.4 When designing do you imagine (or visualise) the design in colour as it develops?
   ○ Yes
   ○ No

If Yes:

2.4.1 Are the colours defined clearly?
   ○ Yes
   ○ No

2.4.2 Do any colours or hues tend to dominate?
   ○ Yes
   ○ No

* If "Yes", tell us which colour:

2.4.3 Are the colour impressions you have while designing similar to the final product/environment?
   ○ Yes
   ○ No
Appendix B: Questionnaire

2.5 What is your tendency towards colour use for interiors of buildings? Please rate your colour preference on a continuum: from 1 (colourless) to 7 (colourful). [--- Select ---]

2.6 What is your tendency towards colour use for exteriors of buildings? Please rate your colour preference on a continuum: from 1 (colourless) to 7 (colourful). [--- Select ---]

Block III: Colour Knowledge

3.1 How important do you think the use of colour is in architecture?

<table>
<thead>
<tr>
<th>Not at all</th>
<th>Minimally important</th>
<th>Somewhat important</th>
<th>Moderately important</th>
<th>Very important</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

3.2 Please self-rate your knowledge of the use of colour in architecture

<table>
<thead>
<tr>
<th>None</th>
<th>Minimal</th>
<th>Below average</th>
<th>Average</th>
<th>Above average</th>
<th>Expert</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

3.3 Please self-rate your knowledge and familiarity with the words below: from 1-6 (please do not augment your existing knowledge by looking up these terms. It is important that we determine your present knowledge.)

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Minimal</td>
<td>Below average</td>
<td>Average</td>
<td>Above average</td>
<td>Expert</td>
</tr>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

3.3.1 RGB

3.3.2 Dimensions of colour

3.3.3 Colour palette

3.3.4 Colour constancy

3.3.5 Munsell

3.3.6 Harmony

3.3.7 Colour therapy

3.3.8 Sigmund

3.3.9 The geography of colour

3.3.10 Simultaneous contrast

3.4.1 Do you know what 'CMYK' stands for (select all that apply)?

☐ (a) Magenta
Appendix B: Questionnaire

3.4.2 The after-image of the colour Red (in white background) is (select all that apply):
- [ ] Red
- [ ] Yellow
- [ ] Blue
- [ ] Green
- [ ] Magenta
- [ ] Don’t know

3.4.3 The primary colours of light (additive colours) are (select all that apply):
- [ ] Red
- [ ] Yellow
- [ ] Blue
- [ ] Green
- [ ] Magenta
- [ ] Don’t know

3.4.4 Which of the following five colours has the highest visual strength?
- [ ] Red
- [ ] Yellow
- [ ] Blue
- [ ] Green
- [ ] Magenta
- [ ] Don’t know

3.4.5 Select the colours that correspond to the subtractive colour primaries (select all that apply):

3.4.6 Select the colour that corresponds to digital representation: R=255, G=0, B=0.

Don’t know
Appendix B: Questionnaire

3.4.7 Select the colour that corresponds to the digital representation: R=255, G=255, B=0.

3.4.8 A 'Magenta' surface is one which
- (a) Absorbs green and reflects red and yellow
- (b) Absorbs red and reflects green and blue
- (c) Absorbs green and reflects red and blue
- (d) Absorbs blue and reflects red and yellow
- (e) Absorbs blue and reflects red and green
- (f) Don't know

3.4.9 What is the Pantone series of colours used for (select all that apply)?
- (a) Allow designers to "colour match" specific colours
- (b) Investigating people's colour knowledge
- (c) Graphic designers and reproduction and printing houses colour selection
- (d) Referencing to colours in different manufacturers
- (e) Testing designer's colour preference
- (f) Don't know

3.4.10 What distinguishes the Natural Colour System from other systems (select all that apply)?
- (a) It builds on how humans see colour
- (b) It is based on three colour dimensions
- (c) It contains a double cone-shaped colour space
- (d) It is based on potentials and limitations of human eyes
- (e) It is divided to 12 hues
- (f) Don't know

Block IV: Colour Education

4.1 In your University or College education and training was the study of colour part of your design course or curriculum?
- (a) Yes
- (b) No

4.1.1 If YES how was this topic taught or integrated into your course?
Appendix B: Questionnaire

Please rate your answers to the following questions from:

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not at all</td>
<td>Minimally</td>
<td>Somewhat</td>
<td>Moderately</td>
<td>Highly</td>
</tr>
</tbody>
</table>

4.2 Do you feel that higher education should play a role in informing knowledge about colour use in architecture? 

4.3 How much do you agree with this statement; “the higher education that I received in colour theory was thorough”? 

4.4 How much do you think that your higher education had an impact on your use of colour when designing? 

4.5 I was often given direction in my design education about the use of colour in my own designs.

<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>

Block V: Colour in Practice

5.1 How often do you engage a colour consultant when designing? 

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not at all</td>
<td>Minimally</td>
<td>Somewhat</td>
<td>Moderately</td>
<td>Highly</td>
</tr>
</tbody>
</table>

5.2 For each of the following four phases of design, how important is the use of colour to your design thinking? 

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>During concept design/idea generation</td>
<td>During schematic design</td>
<td>During design development (for planning and other regulatory requirements)</td>
<td>During detail design - when materials are selected</td>
<td>During the construction phase</td>
</tr>
</tbody>
</table>

5.3 Rate the importance of the following functions of colour in your design process:

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not at all</td>
<td>Minimally important</td>
<td>Somewhat important</td>
<td>Moderately important</td>
<td>Very important</td>
</tr>
</tbody>
</table>

- As an applied decoration; 
- As an integral generator of the design concept; 
- As an element used to contrast or blend a design into its physical context; 
- As an element used to evoke a psychological/emotional response;
Appendix B: Questionnaire

Please rate the following statements from 1-5:

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strongly disagree</td>
<td>Disagree</td>
<td>Neutral</td>
<td>Agree</td>
<td>Strongly agree</td>
</tr>
<tr>
<td>5.1</td>
<td>Architects have an influence on decision-making in the application of colour in the built environment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.2</td>
<td>Clients have an influence on colour decision-making.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.3</td>
<td>For each different design project, designers should try to use a strict colour palette that is informed by the specific urban context.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.4</td>
<td>Developments in digital technology have changed my use of colour in my design.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.5</td>
<td>My attitude towards the use of colour in design has changed across my career.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.6</td>
<td>For all of my designs, I normally stick to a similar colour palette.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.9.1 Please describe your design colour palette (in question 5.9) and the reasons for it:

---

Block VI: Colour in Context

Please rate your answers from 1-5:

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strongly disagree</td>
<td>Disagree</td>
<td>Neutral</td>
<td>Agree</td>
<td>Strongly agree</td>
</tr>
</tbody>
</table>

6.1 Colour is an important consideration when designing:  
- The interiors of buildings;  
- Building exteriors (i.e., facades);  
- Exterior spaces i.e., landscaping.

6.2 How would you rate the impact of each of the following factors on your use of colour in your design work in general?

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not at all</td>
<td>Minimally important</td>
<td>Somewhat</td>
<td>Moderately important</td>
<td>Very Important</td>
</tr>
</tbody>
</table>

- My own cultural background
- Governmental and local planning policies on the use of colour
- The limitations of my own colour knowledge
- The physical and cultural context of the design
- Client preference
- My own colour preferences and attitudes
Appendix B: Questionnaire

Block VII: What informs your design colour choices?

The following section seeks to determine the relative importance of a number of contextual influences for two of your prominent recent design projects (each may be a built project or a hypothetical "paper based" design).

7.1 Please name two of your recent designs:

Project 1:  

Project 2:  

"Project 1"

7.2 Please describe the project typology:

7.3 How colourful was the design? Please rate your colour preference on a continuum: from 1 (colourless) to 7 (colourful)


Please rate your answers from 1 to 5.

7.4 How do you rate the importance of the following contextual influences in your colour selection for this design (Project 1)?

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typology of the design</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
</tr>
<tr>
<td>Urban density of the site</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
</tr>
<tr>
<td>Visible natural features</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
</tr>
<tr>
<td>Colours of immediately neighbouring buildings</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
</tr>
<tr>
<td>Colours of prominent buildings that are visible from the site</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
</tr>
<tr>
<td>Historical use of colour at the site</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
</tr>
<tr>
<td>Building orientation</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
</tr>
<tr>
<td>Building height</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
<td>⬤</td>
</tr>
</tbody>
</table>
Appendix B: Questionnaire

7.5 How much did these people have an impact on your colour choice for your design?  

<table>
<thead>
<tr>
<th>Name</th>
<th>Minimal</th>
<th>Some what</th>
<th>Moderately</th>
<th>Highly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior design consultant</td>
<td>O</td>
<td>O</td>
<td></td>
<td>O</td>
</tr>
<tr>
<td>Client</td>
<td>O</td>
<td>O</td>
<td></td>
<td>O</td>
</tr>
<tr>
<td>Architectural design team</td>
<td>O</td>
<td>O</td>
<td></td>
<td>O</td>
</tr>
<tr>
<td>Contractor/subler</td>
<td>O</td>
<td>O</td>
<td></td>
<td>O</td>
</tr>
<tr>
<td>Local authority/urban planner</td>
<td>O</td>
<td>O</td>
<td></td>
<td>O</td>
</tr>
</tbody>
</table>

7.6 How would you describe the colour palette of your design (Project 1)? (Please tick the relevant adjectives)

- Theoretical
- Predictable
- Innovative
- Safe
- In fashion
- Warm/grade
- Well tailored
- Context sensitive
- End-user sensitive
- Minimal
- Successful
- Driven by available samples
- Climate sensitive
- In the organisational style
- Flashy/boastful
- Beautiful
- Client driven
- Thoughtful
- Based on examples
- Signature of the company
- Cost-effective
- Adventurous
- Conservative
- Functional
- Driven by personal taste

The next two questions ask you to describe the colours you chose for this building using a seven-step semantic differential scales.

7.7 Describe your colour choice for the exterior of the building on the following 7 bipolar scales. For example, for the first pair, 1 describes your choice of colour palette as "harmonious", 7 describes it as "discordant", while a 4 indicates midway between the two extremes.

- Harmonious/discordant
- Pleasant/irritant
- Comfortable/uncomfortable
- Spacious/confined
- Static/dynamic
- Exciting/calming
- Introverted/ extraverted

7.8 Describe your colour choice for the interior of the building on the following 7 bipolar scales. For example, for the first pair, 1 describes your choice of colour palette as "harmonious", 7 describes it as "discordant", while a 4 indicates midway between the two extremes.

- Harmonious/discordant
- Pleasant/irritant
- Comfortable/uncomfortable
Appendix B: Questionnaire

7.9 Did you have any conversation with your client about colour for this project?
- Yes
- No

* If "Yes", please summarise the client's colour preferences/requirements

- [ ]

7.10 Please rate your client's colour range preference for this building on a continuum: from 1 (colourless) to 7 (colourful)

For interior
- [ ]

For exterior
- [ ]

7.11 How much of an influence did this preference have on your colour choice?

<table>
<thead>
<tr>
<th></th>
<th>None</th>
<th>Minimally</th>
<th>Some what</th>
<th>Moderately</th>
<th>Highly</th>
</tr>
</thead>
<tbody>
<tr>
<td>For Interior</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
<tr>
<td>For Exterior</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
<td>☒</td>
</tr>
</tbody>
</table>

7.12 Tell us a little more detail about what informed your choice of colour in this design (Project 1)

- [ ]

7.13 Please describe the project typology:

- "Project 2"
7.14 How colourful was the design?
Please rate your colour preference on a continuum: from 1 (colourless) to 7 (colourful)

( - Select - )

Please rate your answers from 1 to 5

7.15 How do you rate the importance of the following contextual influences in your colour selection for this design (Project 2)?

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimally important</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Somewhat important</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderately important</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very Important</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Typology of the design
- The urban density of the site
- Visible natural features
- Colours of immediately neighboring buildings
- Colours of prominent buildings that are visible from the site
- Historical use of colour at the site
- Building orientation
- Building height
- Building form
- Climatic conditions
- Solar light intensity and angle of the site
- Urban design / planning restrictions
- Cultural content - e.g. customs and religion
- The colour of the building at night
- The psychological impact of colour
- The relative importance of standing out or blending in
- Safety coding
- Perception of space
- Way finding

7.16 How much did these people have an impact on your colour choice for your design?

<table>
<thead>
<tr>
<th></th>
<th>None</th>
<th>Minimally</th>
<th>Somewhat</th>
<th>Moderately</th>
<th>Highly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior design consultant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Client</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Architectural design team</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contractor/builder</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local authority urban planner</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7.17 How would you describe the colour palette of your design (Project 2)? (Please tick the relevant adjectives)

- Theoretical
- Predictable
- Theorized
- Avant-garde
- Well thought
- Driven by available samples/Climate
- Successful
- Client driven
- Thoughtful
- Conservative
- Adventurous
Appendix B: Questionnaire

7.18 Describe your colour choice for the exterior of the building on the following 7 bipolar scales. For example, for the first pair, 1 describes your choice of colour palette as “harmonious”, 7 describes it as “discordant”, while 4 indicates midway between the two extremes.

<table>
<thead>
<tr>
<th>Harmonious/ Discordant</th>
<th>Select</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pleasant/ unpleasant</td>
<td>Select</td>
</tr>
<tr>
<td>Comfortable/ uncomfortable</td>
<td>Select</td>
</tr>
<tr>
<td>Spacious/ confined</td>
<td>Select</td>
</tr>
<tr>
<td>Static/ dynamic</td>
<td>Select</td>
</tr>
<tr>
<td>Exciting/ calming</td>
<td>Select</td>
</tr>
<tr>
<td>Introverted/ extraverted</td>
<td>Select</td>
</tr>
</tbody>
</table>

7.19 Describe your colour choice for the interior of the building on the following 7 bipolar scales. For example, for the first pair, 1 describes your choice of colour palette as “harmonious”, 7 describes it as “discordant”, while 4 indicates midway between the two extremes.

<table>
<thead>
<tr>
<th>Harmonious/ Discordant</th>
<th>Select</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pleasant/ unpleasant</td>
<td>Select</td>
</tr>
<tr>
<td>Comfortable/ uncomfortable</td>
<td>Select</td>
</tr>
<tr>
<td>Spacious/ confined</td>
<td>Select</td>
</tr>
<tr>
<td>Static/ dynamic</td>
<td>Select</td>
</tr>
<tr>
<td>Exciting/ calming</td>
<td>Select</td>
</tr>
<tr>
<td>Introverted/ extraverted</td>
<td>Select</td>
</tr>
</tbody>
</table>

7.20 Did you have any conversation with your client about colour for this project?

- Yes
- No

* If "Yes", please summarize the client's colour preferences/ requirements

7.31 Please rate your client's colour range preferences for this building on a continuum from 1 (colourless) to 7 (colourful)

For interior

--- Select ---
Appendix B: Questionnaire

7.22 How much of an influence did this preference have on your colour choice?

- For Interior
  - None
  - Minimally
  - Somewhat
  - Moderately
  - Highly

- For Exterior
  - None
  - Minimally
  - Somewhat
  - Moderately
  - Highly

7.23 Tell us a little more detail about what informed your choice of colour in this design. (Project 2)

Block VIII: General questions

8.1 How colourful would you say your portfolio of designs are? from 1 (colourless) to 5 (colourful)

- Select --

8.2 How much influence would you say that the following professionals/people have on the colour of the built environment?

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>Minimally</td>
<td>Somewhat</td>
<td>Moderately</td>
<td>Highly</td>
</tr>
</tbody>
</table>

- Urban designer
- Architect
- Client
- Local planning authority
- Specialist colour consultant
- Interior designer

8.3.1 Tell us about other people who influence the use of colour in the built environment.

8.3 It has been argued that architectural design is currently undergoing a paradigm shift in the use of colour, with buildings and cities now reflecting architects’ greater willingness to experiment with colour. What are your thoughts on this?
### Appendix B: Questionnaire

#### 8.4 Is there anything else you would like to add about the topic of colour use in the built environment?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Survey Software Powered by [QuestionPro](https://www.questionpro.com)
Appendix B: Questionnaire

FINAL SURVEY FOR POSTGRADUATE STUDENTS

Survey: STUDENTS EXPERIENCES IN RELATION TO THE USE OF COLOUR IN THE BUILT ENVIRONMENT

STUDENTS EXPERIENCES IN RELATION TO THE USE OF COLOUR IN THE BUILT ENVIRONMENT

The following survey instrument is part of a wider project being investigated by PhD candidate Bahareh Motamed from the School of Architecture and Built Environment at Deakin University, under the supervision of Associate Professor Richard Tucker and Senior Lecturer Margaret Grove.

The survey aims to investigate the impact of architect’s personal and educational backgrounds on their understanding and use of colour. The survey aims to elicit answers to three main questions: (1) how much do architects know about the theory and use of colour? (2) how do architects make colour choices? and (3) what influence does education have on an architect’s use and understanding of colour?

The ultimate aim of this project is to inform curricula renewal around colour knowledge and use in architectural education. Once you have completed the survey, the hypotheses that we are seeking to answer will be explained to you.

On behalf of the team, Associate Professor Richard Tucker and Senior Lecturer Margaret Grove would like to thank you for your contribution to this project.

If you have any questions, or require further assistance in filling this survey, please do not hesitate to contact Bahareh Motamed at bmotame@deakin.edu.au

Plain Language Statement

TO: the HDR student completing the survey “STUDENTS EXPERIENCES IN RELATION TO THE USE OF COLOUR IN THE BUILT ENVIRONMENT”

Full Project Title: Investigation of what informs architect’s colour choices in their design
Principal Researcher: Associate Professor Dr Richard Tucker
Student Researcher: Bahareh Motamed
Associate Researcher(s): Dr Margaret Grove

This survey instrument is part of a wider project being investigated by PhD candidate Bahareh Motamed from the School of Architecture and Built Environment at Deakin University, under the supervision of Associate Professor Richard Tucker and Senior Lecturer Margaret Grove.

This project investigates how much your personal and educational experiences have informed your understanding and use of colour in architecture. It aims ultimately to improve understanding and education around the use of colour in the built environment. You are invited to complete the online survey of “EXPERIENCES IN RELATION TO THE USE OF COLOUR IN THE BUILT ENVIRONMENT.” The survey includes questions about the understanding and use of colour by students and the role of colour study in architectural education. Permission for students to take part in this research has been given by your university. Participation in this research is completely voluntary and not linked to assessment or learning requirements within your area of study. Your decision to take part or not will not affect any marks or grades for any assignment.

The study ultimately aims to enhance teaching and learning in architecture and built environment programs by improving education in colour understanding and its use. Your comments will remain anonymous throughout the PhD thesis, reports and publications developed out of this study. The overall time required for completing the survey is around 25-25 minutes. Accepting and answering, implies your consent for the use of your information in the research. However, if you feel uncomfortable answering any questions, you can withdraw from the survey at any time until the survey is submitted. After submission it is not possible to withdraw your information as the survey is anonymous and cannot be tracked back.

There is no risk involved for participants. Participation in this survey may be beneficial for students and architects who wish to express their views on the place and importance of colour in architectural education. The feedback in this study may inform future guidelines for improving built environment education.
Appendix B: Questionnaire

All data downloaded from the online questionnaires will be stored on a password-protected server at Deakin University for at least a period of 5 years after the final publication of the research outcomes. Data will also be stored on archival storage media that will be kept securely in the principal investigator’s locked cabinet at Deakin University, Geelong Waterfront Campus, for a period of at least 5 years after the final publication of the research outcomes. If you wish to access the results of the survey, or require further clarification regarding the survey and its procedures, you can contact Baharsh Motamed (contact details at the end of this form).

Approval to undertake this project has been given by the Human Ethics Advisory Group (HEAG), Faculty of Science Engineering and Built Environment, Deakin University.

If you have any complaints about any aspect of the project, the way it is being conducted or any questions about your rights as a research participant, then you may contact:
The Manager, Ethics and Biocommunity, Deakin University, 221 Burwood Highway, Burwood Victoria 3125, Telephone: 9251 7829, Facsimile: 9244 6581; research-ethics@deakin.edu.au Please quote project number: NCI-30-2015-MOTAMED.

BAHARSH MOTAMED
PhD Student
School of Architecture and Built Environment
Deakin University
Email: bmotamed@deakin.edu.au
Mobile: 040527794

I have read and understood the attached Plain Language Statement. I hereby agree to participate in this project according to the conditions in the Plain Language Statement. I have been given a copy of the Plain Language Statement and Consent Form to keep. The researcher has agreed not to reveal my identity and personal details, including any information about this project, published or presented in any public form.

☐ I Agree

Block I: Demographics

1.1 Are you?
   - Male
   - Female
   - Prefer not to say

1.2 What is your age range?
   - Under 25
   - 25-39
   - 40-49
   - 50-59
   - Over 50

1.3 Highest completed design degree:
   - Bachelor
   - Master
   - PhD

1.4 What year did you graduate from your most recently completed design degree?
Appendix B: Questionnaire

1.5 Occupation:
- [ ] Student in Architecture
- [ ] Student in Interior Design
- [ ] Architect in practice
- [ ] Urban Designer in practice
- [ ] Academic
- [ ] Other

1.6 In which city do you currently practice or study?

1.7 In which country did you spend the majority of your childhood?

1.8 In which country did you receive each of the following degrees?

1st undergraduate degree

2nd undergraduate degree

Postgraduate degree

1.9 Colour has an important role in the cultural traditions of my home country.

<table>
<thead>
<tr>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
</table>

1.10 Tell us about any colour biases in the visual culture of your home country, and how this is reflected (at all) in the built environment?

Block II: Personal Colour preference and attitude

This question is about your preference for the colourful or colourless. Some of us shy away from colour in our man-made environments.
Appendix B: Questionnaire

preferring the colourless (black, white or greys) or perhaps monochromatic schemes (shades of the same hue), or a small number of hues. While some of us enjoy highly colourful environments.

2.1 Please rate your colour preference on a continuum from 1 (colourless) to 7 (colourful).
--- Select ---

2.2 What is your favorite colour? Why?

2.3 What is your least favorite colour? Why?

2.4 When designing do you imagine (or visualise) the design in colour as it develops?
  - Yes
  - No

If “Yes”:

2.4.1 Are the colours defined clearly?
  - Yes
  - No

2.4.2 Do any colours or hues tend to dominate?
  - Yes
  - No

* If “Yes”, tell us which colour:

2.4.3 Are the colour impressions you have while designing similar to the final product/environment?
  - Yes
  - No
Appendix B: Questionnaire

2.5 What is your tendency towards colour use for interiors of buildings? Please rate your colour preference on a continuum from 1 (colourless) to 7 (colourful).

- Select -

2.6 What is your tendency towards colour use for exteriors of buildings? Please rate your colour preference on a continuum from 1 (colourless) to 7 (colourful).

- Select -

Block III: Colour Knowledge

3.1 How important do you think the use of colour is in architecture?

<table>
<thead>
<tr>
<th>Not at all</th>
<th>Minimally important</th>
<th>Somewhat</th>
<th>Moderately important</th>
<th>Very important</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.2 Please self-rate your knowledge of the use of colour in architecture.

<table>
<thead>
<tr>
<th>None</th>
<th>Minimal</th>
<th>Below average</th>
<th>Average</th>
<th>Above average</th>
<th>Expert</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.3 Please self-rate your knowledge and familiarity with the words below from 1-6 (please do not augment your existing knowledge by looking up these terms. It is important that we determine your present knowledge.)

<table>
<thead>
<tr>
<th>Word</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.3.1 RGB:

3.3.2 Dimensions of colour

3.3.3 Colour palette

3.3.4 Colour constancy

3.3.5 Munsell

3.3.6 Harmony

3.3.7 Colour therapy

3.3.8 Stimmoff

3.3.9 The geography of colour

3.3.10 Simultaneous contrast

3.4.1 Do you know what "CMYK" stands for (select all that apply)?

- Magenta
Appendix B: Questionnaire

3.4.2 The after-image of the colour Red (in white background) is (select all that apply):
- (a) Red
- (b) Yellow
- (c) Blue
- (d) Green
- (e) Magenta
- (f) Don’t know

3.4.3 The primary colours of light (additive colours) are (select all that apply):
- (a) Red
- (b) Yellow
- (c) Blue
- (d) Green
- (e) Magenta
- (f) Don’t know

3.4.4 Which of the following five colours has the highest visual strength?
- (a) Red
- (b) Yellow
- (c) Blue
- (d) Green
- (e) Magenta
- (f) Don’t know

3.4.5 Select the colours that correspond to the subtractive colour primaries (select all that apply):

3.4.6 Select the colour that corresponds to digital representation: R=255, G=0, B=0.
Appendix B: Questionnaire

3.4.7 Select the colour that corresponds to the digital representation: R=255, G=255, B=0.

3.4.8 "Magenta" surface is one which
- (a) Absorbs green and reflects red and yellow
- (b) Absorbs red and reflects green and blue
- (c) Absorbs green and reflects red and blue
- (d) Absorbs blue and reflects red and yellow
- (e) Absorbs blue and reflects red and green
- (f) Don’t know

3.4.9 What is the Pantone series of colours used for (select all that apply)?
- (a) Allow designers to “colour match” specific colours
- (b) Investigating people’s colour knowledge
- (c) Graphics designers and reproduction and printing houses colour selection
- (d) Referencing to colours in different manufacturers
- (e) Testing designer’s colour preference
- (f) Don’t know

3.4.10 What distinguishes the Natural Colour System from other systems (select all that apply)?
- (a) It builds on how humans see colour
- (b) It is based on three colour dimensions
- (c) It contains a double-cone-shaped colour space
- (d) It is based on potentials and limitations of human eyes
- (e) It is divided into 12 hues
- (f) Don’t know

Block IV: Colour Education

4.1 In your University or College education and training was the study of colour part of your design course or curriculum?
- Yes
- No

4.1.1 If "YES" how was this topic taught or integrated into your course?
Appendix B: Questionnaire

Please rate your answers to the following questions from:

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>Minimally</td>
<td>Somewhat</td>
<td>Moderately</td>
<td>Highly</td>
<td></td>
</tr>
</tbody>
</table>

4.2 Do you feel that higher education should play a role in informing knowledge about colour use in architecture?

4.3 How much do you agree with this statement “The higher education that I received in colour theory was thorough”?

4.4 How much do you think that higher education had an impact on your use of colour when designing?

<table>
<thead>
<tr>
<th></th>
<th>Strongly disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.5 I was often given direction in my design education about the use of colour in my own designs.</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
</tbody>
</table>

Block V: Colour in Practice

Please rate your answers to the following questions:

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>Minimally important</td>
<td>Somewhat important</td>
<td>Moderately important</td>
<td>Very Important</td>
<td></td>
</tr>
</tbody>
</table>

5.1 For each of the following four phases of design, how important is the use of colour to your design thinking?

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>During concept design/idea generation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>During schematic design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>During design development (for planning and other regulatory requirements)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>During detail design - when materials are selected</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>During the construction phase</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.2 Rate the importance of the following functions of colour to your design process.

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>Minimally important</td>
<td>Somewhat important</td>
<td>Moderately important</td>
<td>Very Important</td>
<td></td>
</tr>
</tbody>
</table>

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
</tr>
<tr>
<td>As applied decoration;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>As an integral part of the design concept;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>As an element used to contrast or blend a design to its physical context;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>As an element used to encourage a psychological/emotional response;</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Please rate the following statements from 1-5:
**Appendix B: Questionnaire**

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly disagree</td>
<td>Disagree</td>
<td>Neutral</td>
<td>Agree</td>
<td>Strongly agree</td>
</tr>
</tbody>
</table>

5.3 Architects have an influence on decision-making in the application of colour in the built environment.

5.4 Clients have an influence on colour decision-making.

5.5 For each different design project, designers should try to use a strict colour palette that is informed by the specific urban context.

5.6 Developments in digital technology have changed my use of colour in my design.

5.7 My attitude towards the use of colour in design has changed across my career.

5.8 For all of my designs, I normally stick to a similar colour palette.

5.8.1 Please describe your design colour-palette (in question 5.8) and the reasons for it:

---

**Block VI: Colour in Context**

Please rate your answers from 1-5

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly disagree</td>
<td>Disagree</td>
<td>Neutral</td>
<td>Agree</td>
<td>Strongly agree</td>
</tr>
</tbody>
</table>

6.1 Colour is an important consideration when designing:

- The interior of buildings:  
- Building exteriors e.g., facades:  
- Interior spaces i.e., landscaping:

6.2 How would you rate the impact of each of the following factors on your use of colour in your design work in general?

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>Minimally important</td>
<td>Somewhat</td>
<td>Moderately important</td>
<td>Very important</td>
<td>N/A</td>
</tr>
</tbody>
</table>

- My own cultural background
- Governmental and local planning policies on the use of colour
- The limitations of my own colour knowledge
- The physical and cultural context of the design
- Client preference
- My own colour preferences and attitudes
Block VII: What informs your design colour choices?

The following section seeks to determine the relative importance of a number of contextual influences for two of your prominent recent design projects (each may be a built project or a hypothetical "paper based" design).

7.1 Please name two of your recent designs:

Project 1: 

Project 2: 

7.2 Please describe the project typology:

"Project 1"

7.3 How colourful was the design?
Please rate your colour preference on a continuum from 1 (colourless) to 7 (colourful)

[- Select --]

7.4 How do you rate the importance of the following contextual influences in your colour selection for this design (Project 1)?

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimally</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Important</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Somewhat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderately</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Important</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very Important</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Typology of the design
- The urban density of the site
- Visible natural features
- Colour of immediately neighbouring buildings
- Colour of prominent buildings that are visible from the site
- Historical use of colour at the site
- Building orientation
- Building height
- Building form
- Climate conditions
Appendix B: Questionnaire

7.5 How much did these people have an impact on your colour choice for your design?

<table>
<thead>
<tr>
<th>Person</th>
<th>None</th>
<th>Minimally</th>
<th>Somewhat</th>
<th>Moderately</th>
<th>Highly</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior design consultant</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Client</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Architectural design team</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Contractor/builder</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Local authority urban planner</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

7.6 How would you describe the colour palette of your design (Project 1)? (Please tick the relevant adjectives)

<table>
<thead>
<tr>
<th>Adjective</th>
<th>□</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theoretical</td>
<td></td>
</tr>
<tr>
<td>Predictable</td>
<td></td>
</tr>
<tr>
<td>Innovative</td>
<td></td>
</tr>
<tr>
<td>Safe</td>
<td></td>
</tr>
<tr>
<td>In fashion</td>
<td></td>
</tr>
<tr>
<td>Avant garde</td>
<td></td>
</tr>
<tr>
<td>Well made</td>
<td></td>
</tr>
<tr>
<td>Context sensitive</td>
<td></td>
</tr>
<tr>
<td>User sensitive</td>
<td></td>
</tr>
<tr>
<td>Minimal</td>
<td></td>
</tr>
<tr>
<td>Successful</td>
<td></td>
</tr>
<tr>
<td>Driven by available samples</td>
<td></td>
</tr>
<tr>
<td>In the organizational style</td>
<td></td>
</tr>
<tr>
<td>Plush</td>
<td></td>
</tr>
<tr>
<td>Beautiful</td>
<td></td>
</tr>
<tr>
<td>Client driven</td>
<td></td>
</tr>
<tr>
<td>Thoughtful</td>
<td></td>
</tr>
<tr>
<td>Based on examples</td>
<td></td>
</tr>
<tr>
<td>Signature of the company</td>
<td></td>
</tr>
<tr>
<td>Cost-effective</td>
<td></td>
</tr>
<tr>
<td>Adventurous</td>
<td></td>
</tr>
<tr>
<td>Conservative</td>
<td></td>
</tr>
<tr>
<td>Functional</td>
<td></td>
</tr>
<tr>
<td>Driven by personal taste</td>
<td></td>
</tr>
</tbody>
</table>

The next two questions ask you to describe the colours you chose for this building using seven-step semantic differential scales.

7.7 Describe your colour choice for the exterior of the building on the following 7 bipolar scales. For example, for the first pair, 1 describes your choice of colour palette as "harmonious", 7 describes it as "discordant", while a 4 indicates midway between the two extremes.

<table>
<thead>
<tr>
<th>Scale</th>
<th>Select</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harmonious discordant</td>
<td></td>
</tr>
<tr>
<td>Pleasant/unpleasant</td>
<td></td>
</tr>
<tr>
<td>Comfortable/uncomfortable</td>
<td></td>
</tr>
<tr>
<td>Spacious/confined</td>
<td></td>
</tr>
<tr>
<td>Static/dynamic</td>
<td></td>
</tr>
<tr>
<td>Exciting/calming</td>
<td></td>
</tr>
<tr>
<td>Intervened/converted</td>
<td></td>
</tr>
</tbody>
</table>

7.8 Describe your colour choice for the interior of the building on the following 7 bipolar scales. For example, for the first pair, 1 describes your choice of colour palette as "harmonious", 7 describes it as "discordant", while a 4 indicates midway between the two extremes.

<table>
<thead>
<tr>
<th>Scale</th>
<th>Select</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harmonious discordant</td>
<td></td>
</tr>
<tr>
<td>Pleasant/unpleasant</td>
<td></td>
</tr>
<tr>
<td>Comfortable/uncomfortable</td>
<td></td>
</tr>
<tr>
<td>Spacious/confined</td>
<td></td>
</tr>
<tr>
<td>Static/dynamic</td>
<td></td>
</tr>
</tbody>
</table>
Appendix B: Questionnaire

7.9 Tell us a little more detail about what informed your choice of colour in this design (Project 1)

"Project 2"

7.10 Please describe the project typology:

7.11 How colourful was the design? Please rate your colour preference on a continuum from 1 (colourless) to 7 (colourful)

Please rate your answers from 1 to 5

7.12 How do you rate the importance of the following contextual influences on your colour selection for this design (Project 2)?

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typology of the design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The urban density of the site</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visible natural features</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colours of immediately neighbour buildings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colours of prominent buildings that are visible from the site</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Historical use of colour at the site</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building orientation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building height</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building form</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Climate conditions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solar light intensity and angle at the site</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban design/planning restrictions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultural context - e.g. customs and religion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The colour of the building at night</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The psychological impact of colour</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The relative importance of standing out or blending in</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety coding</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perception of space</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix B: Questionnaire

7.1.3 How much did these people have an impact on your colour choice for your design?

<table>
<thead>
<tr>
<th>Role</th>
<th>None</th>
<th>Minimally</th>
<th>Some what</th>
<th>Moderately</th>
<th>Highly</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interior design consultant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Client</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Architectural design team</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contractor/builder</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local authority urban planner</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7.1.4 How would you describe the colour palette of your design (Project 2)? (Please tick the relevant adjective)

- Theoretical
- Predictable
- Innovative
- Safe
- In fashion
- Avant garde
- Well suited
- Context sensitive
- End-user sensitive
- Minimal
- Successful
- Driven by available samples
- Climate sensitive
- In the organisational style
- Flamboyant
- Beautiful
- Client driven
- Thoughtful
- Based on examples
- Signature of the company
- Cost-effective
- Adventurous
- Conservative
- Functional
- Driven by personal taste

The next two questions ask you to describe the colours you chose for this building using 7 seven-step semantic differential scales.

7.1.5 Describe your colour choice for the exterior of the building on the following 7 bipolar scales. For example, for the first pair, 1 describes your choice of colour palette as “harmonious”, 7 describes it as “discordant”, while a 4 indicates midway between the two extremes.

Harmonious/ discordant
- Select

Planned/ unplanned
- Select

Comfortable/ uncomfortable
- Select

Spacious/ confined
- Select

Static/ dynamic
- Select

Exciting/ calming
- Select

Introverted/ extraverted
- Select

7.1.6 Describe your colour choice for the interior of the building on the following 7 bipolar scales. For example, for the first pair, 1 describes your choice of colour palette as “harmonious”, 7 describes it as “discordant”, while a 4 indicates midway between the two extremes.

Harmonious/ discordant
- Select

Planned/ unplanned
- Select

Comfortable/ uncomfortable
- Select

Spacious/ confined
- Select

Static/ dynamic
- Select

Exciting/ calming
- Select

Introverted/ extraverted
- Select

7.1.7 Tell us a little more detail about what informed your choice of colour in this design. (Project 2)
Appendix B: Questionnaire

Block VIII: General questions

8.1 How colourful would you say your portfolio of designs are? from 1 (colourless) to 7 (colourful)
--- Select ---

8.2 How much influence would you say that the following professionals/people have on the colour of the built environment?

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimally</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Somewhat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderately</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highly</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

• Urban designer
• Architect
• Client
• Local planning authority
• Specialist colour consultant
• Interior designer

8.2.1 Tell us about other people who influence the use of colour in the built environment.

8.3 It has been argued that architectural design is currently undergoing a paradigm shift in the use of colour, with buildings and cities now reflecting architects’ greater willingness to experiment with colour. What are your thoughts on this?

8.4 Is there anything else you would like to add about the topic of colour use in the built environment?


Appendix B: Questionnaire

Pilot Survey for Professional and Academic

Survey: Professional Experiences in Colour Use

Survey: Professional & Academic Experiences in Relation to the Use of Colour in the Built Environment.

Professional & Academic Experiences in Relation to the Use of Colour in the Built Environment

The following survey instrument is part of a wider project being investigated by PhD candidate Bahareh Motamed from the School of Architecture and Built Environment at Deakin University, under the supervision of Associate Professor Richard Tucker.

The survey aims to investigate the impact of architects' personal and educational backgrounds on their understanding and use of colour. The survey aims to elucidate answers to three main questions: (1) how much do architects know about the theory and use of colour? (2) how do architects make colour choices? and (3) what influence does education have on an architect's use and understanding of colour?

The ultimate aim of this project is to inform curricula renewal around colour knowledge and use in architectural education.

On behalf of the team, Associate Professor Richard Tucker would like to thank you for your contribution to this project. If you have any questions, or require further assistance in filling this survey, please do not hesitate to contact Bahareh Motamed at bmotamed@deakin.edu.au.

Plain Language Statement

TO: the Practitioners and Academics completing the pilot survey "PROFESSIONAL & ACADEMIC EXPERIENCES IN RELATION TO THE USE OF COLOUR IN THE BUILT ENVIRONMENT."

Full Project Title: An Inquiry into Colour Space and Architectural Choices
Principal Researcher: Associate Professor Dr Richard Tucker
Student Researcher: Bahareh Motamed
Associate Researcher(s): Dr Margaret Grose

This project investigates how much your personal and educational experiences have informed your understanding and use of colour in architecture. It aims ultimately to improve understanding and education around the use of colour in the built environment in Australia. The study will also try to elucidate the reasons for differences between Melbourne and Sydney.

You are invited to complete the online survey "PROFESSIONAL & ACADEMIC EXPERIENCES IN RELATION TO THE USE OF COLOUR IN THE BUILT ENVIRONMENT." The survey includes questions about the understanding and use of colour by designers and academics and the role of colour study in architectural education.

The study aims to enhance teaching and learning in Australian architecture and built environment programs by improving education in colour use and understanding.

Your comments will remain anonymous throughout the PhD thesis, different reports and publications developed out of this study.

The overall time required for completing the survey is around 25-35 minutes. Accepting and answering, implies your consent for the use of your information in the research. Your participation is voluntary and your participation (or not) will not have any effect on your relationship with your employer or any relationship with Deakin University. No personal information has been supplied to the researcher or Deakin University. However, if you feel uncomfortable answering any questions, you can withdraw from the survey at any time up until the survey is submitted. After submission it is not possible to withdraw your information as the survey is anonymous and cannot be tracked back.
Appendix B: Questionnaire

There is no risk involved for participants. Participation in this survey may be beneficial for architects who wish to express their views on the place and importance of colour in architectural education. The feedback in this study may inform future guidelines for improving built environment education and curriculum.

All data downloaded from the online questionnaire will be stored on a password-protected server at Deakin University for at least a period of 5 years after the final publication of the research outcomes. The data will also be stored on archival storage media that will be kept securely in the principal investigator’s locked cabinet at Deakin University, Geelong Waterfront Campus, for a period of at least 5 years after the final publication of the research outcomes.

If you wish to access the results of the survey, or require further clarification regarding the survey and its procedures, you can contact Bahareh Motamed (contact details at the end of this form).

Approval to undertake this project has been given by the Human Ethics Advisory Group (HEAG), Faculty of Science Engineering and Built Environment, Deakin University. If you have any complaints about any aspect of the project, the way it is being conducted or any questions about your rights as a research participant, then you may contact:

The Manager, Ethics and Biosafety, Deakin University, 221 Burwood Highway, Burwood Victoria 3125, Telephone: 9261 7129, Facsimile: 9264 6581; research-ethics@deakin.edu.au

Please quote project number: STEC-44-2014-MOTAMED.

BAHAREH MOTAMED
PhD Student
School of Architecture and Built Environment
Deakin University
Email: bhotamed@deakin.edu.au
Mobile: 0405277934

I have read and I understand the attached Plain Language Statement.
I freely agree to participate in this project according to the conditions in the Plain Language Statement.
I have been given a copy of the Plain Language Statement and Consent Form to keep.
The researcher has agreed not to reveal my identity and personal details, including where information about this project is published, or presented in any public form.
☐ I Agree

Section I

1.1 Are you?
- Male
- Female
- Prefer not to say

1.2 What is your age range?
- Under 22
- 22-30
- 31-40
- 41-50
- Over 50

1.3 Highest completed design degree:
- Bachelor
- Master
- PhD
Appendix B: Questionnaire

1.4 What year did you graduate from your most recently completed design degree?

1.5 Occupation *
- Student
- Architect in practice
- Academic

1.6 In which city do you currently practise or study?

1.7 In which country did you spend the majority of your childhood?

1.8 In which country did you receive your undergraduate degree?

1.9 In which country (if any) did you receive your post-graduate degree?

1.10 Did you study any course at university related to the use of colour in design?
- Yes
- No
Appendix B: Questionnaire

1.10.1 If YES please state the course name? And what have you studied about colour in that course?

1.11 The higher education that I received in colour theory was thorough.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1.12(e) Is colour important in your approach to design?

- [ ] Yes
- [x] No

1.12 (b) Please explain why

1.13 When colour has been an important element of your designs, what are some of the reasons that have informed this importance?

1.14 What do you consider to be the most significant events and influences in the design history of the city in which you work that have impacted the use of colour there in the built environment?

1.15 Rate the importance of the following qualities and characteristics to your design priorities

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>Minimally important</td>
<td>Somewhat</td>
<td>Moderately important</td>
<td>Very important</td>
</tr>
<tr>
<td>Light</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>Reflectivity</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>Functionality</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>Form</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>Ornament</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
</tbody>
</table>
Appendix B: Questionnaire

1.16 If there are any qualities not listed above that you wish to add please write them here:


Section II

2.1 How do you rate your knowledge of the use of colour in architecture?

<table>
<thead>
<tr>
<th></th>
<th>Don't know</th>
<th>Below average</th>
<th>Average</th>
<th>Above average</th>
<th>Expert</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

2.2 How important do you think the use of colour is in architecture?

<table>
<thead>
<tr>
<th></th>
<th>Not at all</th>
<th>Minimally important</th>
<th>Somewhat</th>
<th>Moderately important</th>
<th>Very important</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

2.2.1 What informs your rating above Q 2.2?


2.3 How important to how you use colour in architecture are the following factors?

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Minimally</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Somewhat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderately</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very important</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

- Symbolic meaning of colour
- The role of colour in your own culture
- The understanding and importance of colour in your home country
- Customs
Appendix B: Questionnaire

2.4 How important is colour culturally in your home country?

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

2.5 Rate the importance of the use of colour:

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>As decoration</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>As a part of the design concept</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>As a functional element</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

Please rate your answers

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disagree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neutral</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly Agree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.6 Knowledge of colour is important to architectural design

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

2.7 Higher education should play a role in informing knowledge about colour use in architecture

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

2.8 How much do you think that the design aesthetic/philosophy/dance of your school has impacted the way you use colour in your designs?

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimally</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Somewhat</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modestly</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highly</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.8.1 What informs your rating in the Question 2.8 above?

Please rate your answers

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Disagree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disagree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neutral</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly Agree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.9 Higher education had an impact on my understanding of the use of colour

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

2.10 Architects have significant responsibility for the colour of the built environment

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
Appendix B: Questionnaire

2.10.1 What informs your rating in the Questions 2.10 above?

2.11 What movement, if any, would you most strongly align your design principles to (e.g. Modernism, Post modernism, Deconstructivism, High tech)?

Please rate your answers

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>Minimally</td>
<td>Somewhat</td>
<td>Moderately</td>
<td>Highly</td>
</tr>
</tbody>
</table>

2.12 How do you rate the impact of practical experience on your use of colour in your design process?

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.13 How important are the following factors when choosing colour for your designs?

- Function
- Design concept
- Decoration
- Climatic and geographic conditions
- Cultural context
- Meaning of colours
- Historical context
- Surrounding built environment

Please rate your answers

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>Minimally important</td>
<td>Somewhat</td>
<td>Moderately important</td>
<td>Very important</td>
</tr>
</tbody>
</table>

2.14 If there are other factors that have an effect on your colour choices please add them here

Please rate your answers

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix B: Questionnaire

2.15 How do you rate the importance of these different ways of introducing colour in architectural designs?

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Via natural colour of material</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Via lighting</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Via applied paint</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Via vegetation</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
</tbody>
</table>

Please rate your answers:

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>Minimally important</td>
<td>Somewhat</td>
<td>Moderately important</td>
<td>Very Important</td>
<td></td>
</tr>
</tbody>
</table>

2.16 When choosing an applied paint finish, how important is the choice of colour in relation to your design concept?

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
</tbody>
</table>

2.17 How important is the consideration of colour in the different stages below of the design process?

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design concept</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Ideation</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Finished building</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
</tbody>
</table>

2.18 How do you rate the importance of colour in

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interiors</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Building Facades</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Landscaping</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
</tbody>
</table>

2.19 How important are the natural environmental characteristics of the prospective building location to your colour choice and use?

2.20 How important is the nighttime appearance of buildings to your colour decision making?

2.21 Please explain how your colour choice might be informed to reflect nighttime appearance?
Appendix B: Questionnaire

Please rate your answers

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>Minimally important</td>
<td>Somewhat important</td>
<td>Moderately important</td>
<td>Very important</td>
</tr>
</tbody>
</table>

2.22 How do you rate the importance of the following environmental factors in your colour selection?

- Climatic conditions
- Geographic location
- Natural features
- Solar light intensity and angle
- Shadow

2.23 How do you rate the importance to your colour use of the following socio-cultural factors?

- Aesthetics taste of stakeholders/client
- Symbolic meaning of colour in that society
- Cultural and religious values of colours in that society
- Personality traits of designer

2.24 How do you rate the impact of governmental and local planning policies on colour use?

2.25 How do you rate the impact of heritage and conservation restrictions on your use of colour?

2.26 Who is most responsible for colour choices in our built environment? Please explain your answer if you wish.

Please rate your answers

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>Minimally important</td>
<td>Somewhat important</td>
<td>Moderately important</td>
<td>Very important</td>
</tr>
</tbody>
</table>

2.27 How important is the role of the architect in colour use in the built environment?

2.28 How important is the impact of cultural tradition to your colour choices?
Appendix B: Questionnaire

2.29 Rate the importance of the following potential barriers to colour selection

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban design rules and policies</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Customs and religion</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Architectural heritage</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>City vision for future</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Architectural style</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

2.29.1 What informs your ratings for Q2.29 above?

2.30 If there are any other barriers not listed above please add them below?

2.31 Please rate (as a percentage) the relative impact of each of the following three factors on your use of colour in design. Your three answers should add up to 100% - e.g. 20%, 30%, and 50%

<table>
<thead>
<tr>
<th>Factor</th>
<th>20%</th>
<th>30%</th>
<th>50%</th>
</tr>
</thead>
<tbody>
<tr>
<td>My own cultural background and colour preferences</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>My design education</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>The physical and cultural context of the design</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Section III

3.1 Please rate your knowledge and familiarity with words below from 1-6 and also please write a short description about them

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Don't know</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below average</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Above average</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expert</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| 3.1.1 NCS                      |     |     |     |     |     |
| 3.1.2 Colour theory            |     |     |     |     |     |
| 3.1.3 Dimensions of colour    |     |     |     |     |     |
| 3.1.4 Svirnoff                 |     |     |     |     |     |
| 3.1.5 Colour constancy         |     |     |     |     |     |
| 3.1.6 Munsell                  |     |     |     |     |     |
| 3.1.7 Harmony                  |     |     |     |     |     |
| 3.1.8 Colour therapy           |     |     |     |     |     |
Appendix B: Questionnaire

3.1.9 Saturation
3.1.10 The geography of colour
3.1.11 After image
3.1.12 Colour palette
3.1.13 Simultaneous contrast
3.1.14 Terra Cotta
3.1.15 Vernacular eye
3.1.16 Wittgenstein

3.1.17 Please do not augment your existing knowledge by looking up these terms. It is important that we determine your present knowledge.

NCS

Colour theory

Dimensions of colour

Swirnow

Colour constancy

Munsell

Harmony

Colour therapy
Appendix B: Questionnaire

3.2 Please select your answer in the multiple choice questions below

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Don't know</td>
<td>Strongly Disagree</td>
<td>Somewhat Disagree</td>
<td>Somewhat Agree</td>
<td>Strongly Agree</td>
</tr>
</tbody>
</table>

3.2.1 There should be a strict colour palette for designers to use according to the specific urban context

3.2.2 Particular colours have the ability to influence the perception of room size

3.2.3 It is possible to reduce the perceived weight of buildings through the use of colour

3.2.4 Research on colour psychology is rather meaningless since colour is mostly a matter of personal

Please select your answer (1) Don't know, (2) Strongly Disagree, (3) Somewhat Disagree, (4) Somewhat Agree, (5) Strongly Agree.
Appendix B: Questionnaire

3.3 Please answer the following open-ended questions without reference to any external sources of information:

3.3.1 Can you name three key texts in the field of colour use?

3.3.2 Can you name any article or author in the field of colour study?

3.3.3 What can be the reasons for colour use in architecture in your opinion?

3.3.4 What kind of problem may be solved by good colour research?

3.3.5 What kind of colour information or training do you feel students of architecture need?

3.3.6 In which courses/units do you think colour study should be taught?

3.3.7 Who should make decisions for cities about the architectural use of colour?
3.3.8 This is a pilot survey. How do you think its design could be improved e.g. does it ask the right questions?

3.3.9 Is there anything else you would like to add?

Applicant's note: Thank you statement appears once survey completed. Thank you for taking a time to participate in our survey. We truly value the information you have provided. Your responses are vital in helping us to provided a comprehensive research about the place of colour in architectural education.
Appendix B: Questionnaire

PILOT SURVEY FOR POSTGRADUATE STUDENTS

Survey: STUDENTS EXPERIENCES IN COLOUR USE

Survey: STUDENTS EXPERIENCES IN RELATION TO THE USE OF COLOUR IN THE BUILT ENVIRONMENT.

STUDENTS EXPERIENCES IN RELATION TO THE USE OF COLOUR IN THE BUILT ENVIRONMENT

The following survey instrument is part of a wider project being investigated by PhD candidate Bahareh Motamed from the School of Architecture and Built Environment at Deakin University, under the supervision of Associate Professor Richard Tucker. The survey aims to investigate the impact of architects’ personal and educational backgrounds on their understanding and use of colour. The survey aims to elicit answers to three main questions: (1) how much do architects know about the theory and use of colour? (2) how do architects make colour choices? and (3) what influence does education have on an architect’s use and understanding of colour? The ultimate aim of this project is to inform curricula renewal around colour knowledge and use in architectural education. On behalf of the team, Associate Professor Richard Tucker would like to thank you for your contribution to this project. If you have any questions, or require further assistance in filling this survey, please do not hesitate to contact Bahareh Motamed at bmotamed@deakin.edu.au

Plain Language Statement

TO: the students completing the pilot survey “STUDENTS EXPERIENCES IN RELATION TO THE USE OF COLOUR IN THE BUILT ENVIRONMENT.”

Full Project Title: An Inquiry into Colour Space and Architectural Choices
Principal Researcher: Associate Professor Dr Richard Tucker
Student Researcher: Bahareh Motamed
Associate Researcher(s): Dr Margaret Grose

This project investigates how much your personal and educational experiences have informed your understanding and use of colour in architecture. It aims ultimately to improve understanding and education around the use of colour in the built environment in Australia. The study will also try to elucidate the reasons for any differences between colour-use in different cities. You are invited to complete the online survey of “EXPERIENCES IN RELATION TO THE USE OF COLOUR IN THE BUILT ENVIRONMENT.” The survey includes questions about the understanding and use of Colour by designers and academics and the role of colour study in architectural education. Participation in this research is completely voluntary and not linked to assessment or learning requirements within your unit/course of study. The study ultimately aims to enhance teaching and learning in Australian architecture and built environment programs by improving education in colour understanding and its use. Your comments will remain anonymous throughout the PhD thesis, reports and publications developed out of this study. The overall time required for completing the survey is around 25-35 minutes. Accepting and answering implies your consent for the use of your information in the research. However, if you feel uncomfortable answering any questions, you can withdraw from the survey at any time until the survey is submitted. After submission, it is not possible to withdraw your information as the survey is anonymous and cannot be tracked back. There is no risk involved for participants. Participation in this survey may be beneficial for students and architects who wish to express their views on the place and importance of colour in architectural education and how they expect to change it. The feedback in this study may inform future.
Appendix B: Questionnaire

Guidelines for improving built environment education and curriculum. All data downloaded from the online questionnaire will be stored on a password-protected server at Deakin University for at least a period of 5 years after the final publication of the research outcomes. Data will also be stored on archival storage media that will be kept securely in the principal investigator’s locked cabinet at Deakin University, Geelong Waterfront Campus, for a period of at least 5 years after the final publication of the research outcomes. If you wish to access the results of the survey, or require further clarification regarding the survey and its procedures, you can contact Bahareh Motamed (contact details at the end of this form).

Approval to undertake this project has been given by the Human Ethics Advisory Group (HEAG), Faculty of Science Engineering and Built-Environment, Deakin University. If you have any complaints about any aspect of the project, the way it is being conducted or any questions about your rights as a research participant, then you may contact: The Manager, Ethics and Biosafety, Deakin University, 221 Burwood Highway, Burwood Victoria 3125, Telephone: 9251 7129, Facsimile: 9244 6581; research-ethics@deakin.edu.au Please quote project number: STEC-44-2014-MOTAMED.

BAHAREH MOTAMED
PhD Student
School of Architecture and Built Environment
Deakin University
Email: bmotamed@deakin.edu.au
Mobile: 0405277934

I have read and I understand the attached Plain Language Statement. I freely agree to participate in this project according to the conditions in the Plain Language Statement. I have been given a copy of the Plain Language Statement and Consent Form to keep. The researcher has agreed not to reveal my identity and personal details, including where information about this project is published, or presented in any public form.
☐ I Agree

Section 1

1.1 Are you?
☐ Male
☐ Female
☐ Prefer not to say

1.2 What is your age range?
☐ Under 22
☐ 22-30
☐ 31-40
☐ 41-50
☐ Over 50

1.3 Higher completed design Degree :
☐ Bachelor
☐ Master
☐ PhD
1.4 What year did you graduate from your most recently completed design degree?

1.5 Occupation: *
- Student
- Architect in practice
- Academic

1.6 In which city do you currently practise or study?

1.7 In which country did you spend the majority of your childhood?

1.8 In which country did you receive your undergraduate degree? *

1.9 In which country (if any) did you receive your post-graduate degree? *

1.10 Did you study any course at university related to the use of colour in design?
- Yes
- No
Appendix B: Questionnaire

1.10.1 If YES please state the course name? And what have you studied about colour in that course?


1.11 The higher education that I received in colour theory was thorough

<table>
<thead>
<tr>
<th>Strongly Disagree (1)</th>
<th>Disagree (2)</th>
<th>Neutral (3)</th>
<th>Agree (4)</th>
<th>Strongly Agree (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

1.12 (a) Is colour important in your approach to design?
- Yes
- No

1.12(b) Please explain why.


1.13 When colour has been an important element of your designs, what are some of the reasons that have informed this importance?


1.14 Rate the importance of the following characteristics to your design priorities

<table>
<thead>
<tr>
<th>Light</th>
<th>Reflectivity</th>
<th>Functionality</th>
<th>Form</th>
<th>Ornament</th>
<th>Materiality</th>
<th>Tectonics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>Minimally important</td>
<td>Somewhat</td>
<td>Moderately important</td>
<td>Very Important</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
Appendix B: Questionnaire

1.15 If there are any qualities not listed above that you wish to add please write them here:

Section II

2.1 How do you rate your knowledge about the use of colour in architecture?

<table>
<thead>
<tr>
<th>Don't know (1)</th>
<th>Below average (2)</th>
<th>Average (3)</th>
<th>Above average (4)</th>
<th>Expert (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.2 How important do you think the use of colour is in architecture?

<table>
<thead>
<tr>
<th>Not at all (1)</th>
<th>Minimally important (2)</th>
<th>Somewhat (3)</th>
<th>Moderately important (4)</th>
<th>Very important (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.2.1 What informs your rating in Q 2.2 above?

2.3 How important to you do you use colour in architecture are the following factors?

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>Minimally important</td>
<td>Somewhat</td>
<td>Moderately important</td>
<td>Very Important</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Symbolic meaning of colour
- The role of colour in your own culture
- The understanding and importance of colour in your home country
- Customs
- Beliefs
- The alleged healing effect of colour
### Appendix B: Questionnaire

2.4 How important is colour culturally in your home country?

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.5 Rate the importance of the use of colour:

- As decoration
- As a part of the design concept
- As a functional element

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Please rate your answers:

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.6 Knowledge of colour is important to architectural design

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.7 Higher education should play a role in informing knowledge about colour use in architecture

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.8 How much do you think that the design aesthetic/philosophy/stance of your school has impacted the way you use colour in your designs?

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.8.1 What informs your rating in the Question 2.8 above?

Please rate your answers:

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.9 Higher education had an impact on my understanding of the use of colour

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.10 Architects have significant responsibility for the colour of the built environment

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2.10.1 What informs your ratings in the Question 2.10 above?


2.11 What movement, if any, would you most strongly align your design principal to (e.g. Modernism, Post modernism, Deconstructivism, High tech)?


2.12 How do you rate the impact of practical experience on your use of colour in your design process?

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Minimally</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Somewhat</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Moderately</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>High</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

2.13 How important are the following factors when choosing colour for your designs?

- Function
- Design concept
- Decoration
- Climatic and geographic conditions
- Cultural context
- Meaning of colours
- Historical context
- Surrounding built environment

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

2.14 If there are other factors that have an effect on your colour choices please add them here


2.15 How do you rate the importance of these different ways of introducing colour in architectural designs?

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Minimally important</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Somewhat</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Moderately important</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Very Important</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>
Appendix B: Questionnaire

2.16 When choosing an applied paint finish, how important is the choice of colour in relation to your design concept?

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.17 How important is the consideration of colour in the different stages below of the design process?

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.18 How do you rate the importance of colour in...

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.19 How important are natural environmental characteristics of the prospective building location to your colour choice and use?

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.20 How do you rate the importance of following environmental factors in your colour selection?

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## APPENDIX B: QUESTIONNAIRE

### 2.21 How do you rate the importance to your colour use of the following socio-cultural factors?

<table>
<thead>
<tr>
<th>Factor</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aesthetics taste of stakeholders/client</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>O</td>
</tr>
<tr>
<td>Symbolic meaning of colour in that society</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>O</td>
</tr>
<tr>
<td>Cultural and religious values of colours in that society</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>O</td>
</tr>
<tr>
<td>Personality traits of designer</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>O</td>
</tr>
</tbody>
</table>

### 2.22 How do you rate the impact of governmental and local planning policies on your use of colour?

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

### 2.23 Who is most responsible for colour choices in our built environment? Please explain your answer if you wish.

### Please rate your answers

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>Minimally important</td>
<td>Somewhat</td>
<td>Moderately important</td>
<td>Very Important</td>
<td></td>
</tr>
</tbody>
</table>

### 2.24 How important is the role of the architect in colour use in the built environment?

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

### 2.25 How important is the impact of customs/tradition to your colour choices?

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

### 2.26 Rate the importance of the following potential barriers to colour selection

<table>
<thead>
<tr>
<th>Factor</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban rules and policies</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Customs and religion</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Architectural heritage</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>City vision for future</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Architectural style</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

### 2.26.1 What informs your rating for Q 2.26 above?


Appendix B: Questionnaire

2.27 If there are any other barriers not listed above please add them below:

2.28 How would you rate the relative impact of each of the following factors on your use of colour in design? Please rate (as a percentage) the relative impact of each of the following three factors on your use of colour in design. Your three answers should add up to 100% - e.g. 20%, 30%, and 50%

<table>
<thead>
<tr>
<th>Factor</th>
<th>20%</th>
<th>30%</th>
<th>50%</th>
</tr>
</thead>
<tbody>
<tr>
<td>My own cultural background and colour preferences</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>My design education</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>The physical and cultural context of the design</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

Section III

3.1 Please rate your knowledge and familiarity with words below from 1-5 and also please write a short description about them:

<table>
<thead>
<tr>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Don't know</td>
<td>Below average</td>
<td>Average</td>
<td>Above average</td>
<td>Expert</td>
</tr>
</tbody>
</table>

3.1.1 NCS
3.1.2 Colour theory
3.1.3 Dimensions of colour
3.1.4 Swinoff
3.1.5 Colour constancy
3.1.6 Munsell
3.1.7 Harmony
3.1.8 Colour therapy
3.1.9 Saturation
3.1.10 The geography of colour
3.1.11 After image
3.1.12 Colour palette
3.1.13 Simultaneous contrasting
3.1.14 Terra Cotta
3.1.15 Vernacular eye
3.1.16 Wittgenstein

3.1.17 Please do not augment your existing knowledge by looking up these terms. It is important that we determine your present knowledge.
Appendix B: Questionnaire

NCS

Colour theory

Dimensions of colour

Swirnoff

Colour constancy

Munsell

Harmony

Colour therapy

Saturation

The geography of colour

After image
Appendix B: Questionnaire

3.2 Please select your answer in the multiple choices questions below:

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Don't Know</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Somewhat Disagree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Somewhat Agree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strongly Agree</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.2.1 There should be a strict colour palette for designers to use according to the specific urban context

3.2.2 Particular colours have the ability to influence the perception of room size

3.2.3 It is possible to reduce the perceived weight of buildings through the use of colour

3.2.4 Research on colour psychology is rather meaningless since colour is mostly a matter of taste

3.2.5 Too much knowledge about colour and colour research hampers the designer’s freedom to
Appendix B: Questionnaire

3.3 Please answer the following open-ended questions without reference to any external sources of information:

3.3.1 Can you name three key texts in the field of colour use?

3.3.2 Can you name any article or author in the field of colour study?

3.3.3 What can be the reasons for colour use in architecture in your opinion?

3.3.4 What kind of problem may be solved by good colour research?

3.3.5 What do/did you expect from academic education in learning about colour?

3.3.6 In which courses/units do you think colour study should be taught?
3.3.7 What kind of colour information is necessary to receive in architectural education that can be useful for your design practice?


3.3.8 Who should make decisions for cities about the architectural use of colour?


3.3.9 Is there anything else you would like to add?


APPENDIX C:

ETHICS APPROVAL AND DOCUMENTATION
APPENDIX C – Ethics Approval and Documentation

ETHICS APPROVAL FOR FINAL SURVEY IN AUSTRALIA

Bahareh Motamed
School of Architecture and Built Environment
Waterfront Campus
cc. Associate Professor Richard Tucker:
Dr Margaret Grose

14 September 2015

Dear Bahareh,

STEC-44-2014-MOTAMED (MOD-03) titled “An inquiry into colour, space and architectural choices”

Thank you for submitting a request for modification to the above project for consideration by the Faculty Human Ethics Advisory Group (HEAG). The HEAG recognised that the project complies with the National Statement on Ethical Conduct in Human Research (2007) and has approved it. You may commence the project upon receipt of this communication.

The approval period is for three years. It is your responsibility to contact the Faculty HEAG immediately should any of the following occur:

- Serious or unexpected adverse effects on the participants
- Any proposed changes in the protocol, including extensions of time
- Any changes to the research team or changes to contact details
- Any events which might affect the continuing ethical acceptability of the project
- The project is discontinued before the expected date of completion.

You will be required to submit an annual report giving details of the progress of your research. Please forward your first annual report on 14/9/16 Failure to do so may result in the termination of the project.

Once the project is completed, you will be required to submit a final report informing the HEAG of its completion.

Please ensure that the Deakin logo is on the Plain Language Statement and Consent Forms. You should also ensure that the project ID is inserted in the complaints clause on the Plain Language Statement, and be reminded that the project number must always be quoted in any communication with the HEAG to avoid delays. All communication should be directed to scientific@deakin.edu.au

The Faculty HEAG and/or Deakin University Human Research Ethics Committee (HREC) may need to audit this project as part of the requirements for monitoring set out in the National Statement on Ethical Conduct in Human Research (2007).

If you have any queries in the future, please do not hesitate to contact me.

We wish you well with your research.

Kind regards

Sandra Dunoon
Secretary, Human Ethics Advisory Group (HEAG)
Faculty of Science Engineering & Built Environment

Signature Redacted by Library
Appendix C: Ethics Approval and Documentation

Ethics approval for final survey in Iran

Assoc Prof Richard Tucker; Bahareh Motamed
School of Architecture & Built Environment
Waterfront Campus
cc Dr Margaret Grose
9 September 2015

Dear Bahareh

STEC-30-2015-MOTAMED titled “Investigation of what informs architects colour choices in their design”

Thank you for submitting the above project for consideration by the Faculty Human Ethics Advisory Group (HEAG). The HEAG recognised that the project complies with the National Statement on Ethical Conduct in Human Research (2007) and has approved it. You may commence the project upon receipt of this communication.

The approval period is for three years. It is your responsibility to contact the Faculty HEAG immediately should any of the following occur:

- Serious or unexpected adverse effects on the participants
- Any proposed changes in the protocol, including extensions of time
- Any changes to the research team or changes to contact details
- Any events which might affect the continuing ethical acceptability of the project
- The project is discontinued before the expected date of completion.

The Principal Investigator will be required to submit an annual report giving details of the progress of your research. Please forward your first annual report on 9/9/16. Failure to do so may result in the termination of the project. Once the project is completed, you will be required to submit a final report informing the HEAG of its completion.

Please ensure that the Deakin logo is on the Plain Language Statement, Consent Forms and all other documentation provided to participants. You should also ensure that the project ID is inserted in the complaints clause on the Plain Language Statement and Consent forms, and be reminded that the project number must always be quoted in any communication with the HEAG to avoid delays. All communication should be directed to sciethic@deakin.edu.au

The Faculty HEAG and/or Deakin University Human Research Ethics Committee (HREC) may need to audit this project as part of the requirements for monitoring set out in the National Statement on Ethical Conduct in Human Research (2007).

If you have any queries in the future, please do not hesitate to contact me.

We wish you well with your research.

Kind regards

Sandra Dunson
Secretary, Human Ethics Advisory Group (HEAG)
Faculty of Science, Engineering and Built Environment

Signature Redacted by Library

Ethics approval for Pilot survey in Australia
Appendix C: Ethics Approval and Documentation

Bahareh Motamed
School of Architecture & Built Environment
cc: Assoc Prof Richard Tucker
Dr Margaret Grove

Dear Bahareh,

STEC-44-2014-MOTAMED

Thank you for submitting the above project for consideration by the Faculty Human Ethics Advisory Group (HAG). The HAG has recognised that the project complies with the National Statement on Ethical Conduct in Human Research (2007) and has approved it. You may commence the project upon receipt of this communication.

The approval period is for three years. It is your responsibility to contact the Faculty HAG immediately should any of the following occur:

- Serious or unexpected adverse effects on the participants
- Any proposed changes in the protocol, including extensions of time
- Any changes to the research team or changes to contact details
- Any events which might affect the continuing ethical acceptability of the project
- The project is discontinued before the expected date of completion.

The Principal Investigator will be required to submit an annual report giving details of the progress of your research. Please forward your first annual report on 31/1/11. Failure to do so may result in the termination of the project. Once the project is completed, you will be required to submit a final report informing the HAG of its completion.

Please ensure that the Deakin logo is on the Plain Language Statement, Consent Forms and all other documentation provided to participants. You should also ensure that the project ID is inserted in the complaints cause on the Plain Language Statement and Consent forms, and be reminded that the project number must always be quoted in any communication with the HAG to avoid delays. All communication should be directed to ethics@deakin.edu.au

The Faculty HAG and/or Deakin University Human Research Ethics Committee (HREC) may need to audit this project as part of the requirements for monitoring set out in the National Statement on Ethical Conduct in Human Research (2007).

If you have any queries in the future, please do not hesitate to contact me.

We wish you well with your research.

Kind regards,

Sandra Dunlop
Secretary, Human Ethics Advisory Group (HAG)
Faculty of Science, Engineering and Built Environment

Signature Redacted by Library

Faculty of Science and Technology Human Ethics Advisory Group
Deakin University Waurn Ponds Campus, Geelong, VIC 3216
Tel 03 522 72270 Fax 03 522 72272 ethics@deakin.edu.au, www.deakin.edu.au
OHS0287/Provider Code: 508225B
PLAIN LANGUAGE STATEMENT

To: the Practitioners and Academics completing the survey “PROFESSIONAL & ACADEMIC EXPERIENCES IN RELATION TO THE USE OF COLOUR IN THE BUILT ENVIRONMENT.”

Plain Language Statement

Date:

Full Project Title: Investigation of what informs architect’s colour choices in their design

Student Researcher: [PhD Candidate] Bahareh Motamed

Principal Researcher: [PhD Principal Supervisor] Associate Professor Dr Richard Tucker

Associate Researcher: [PhD Associate Supervisor] Dr Margaret Grose

This survey instrument is part of a wider project being investigated by PhD candidate Bahareh Motamed from the School of Architecture and Built Environment at Deakin University, under the supervision of Associate Professor Richard Tucker and Senior Lecturer Margaret Grose.

This project investigates how much your personal and educational experiences have informed your understanding and use of colour in architecture. It aims ultimately to improve understanding and education around the use of colour in the built environment.

You are invited to complete the online survey “PROFESSIONAL & ACADEMIC EXPERIENCES IN RELATION TO THE USE OF COLOUR IN THE BUILT ENVIRONMENT.” The survey includes questions about the understanding and use of colour by designers and academics and the role of colour study in architectural education.

The study ultimately aims to enhance teaching and learning architecture and built environment programs by improving education in colour understanding and its use.

Your comments will remain anonymous throughout the PhD thesis, reports and publications developed out of this study.

The overall time required for completing the survey is around 25-35 minutes. Accepting and answering; implies your consent for the use of your information in the research. However, if you feel uncomfortable answering any questions, you can withdraw from the survey at any time up until the survey is submitted. After submission, it is not possible to withdraw your information as the survey is anonymous and cannot be tracked back.
Appendix C: Ethics Approval and Documentation

There is no risk involved for participants. Participation in this survey may be beneficial for architects who wish to express their views on the place and importance of colour in architectural education. The feedback in this study may inform future guidelines for improving built environment education and curriculum.

All data downloaded from the online questionnaire will be stored on a password-protected server at Deakin University for at least a period of 5 years after the final publication of the research outcomes. Data will also be stored on archival storage media that will be kept securely in the principal investigator’s locked cabinet at Deakin University, Geelong Waterfront Campus, for a period of at least 5 years after the final publication of the research outcomes.

If you wish to access the results of the survey, or require further clarification regarding the survey and its procedures, you can contact Bahareh Motamed (contact details at the end of this form).

Approval to undertake this project has been given by the Human Ethics Advisory Group (HEAG), Faculty of Science Engineering and Built-Environment, Deakin University. If you have any complaints about any aspect of the project, the way it is being conducted or any questions about your rights as a research participant, then you may contact:

The Manager, ‘Ethics and Biosafety, Deakin University, 221 Burwood Highway, Burwood Victoria 3125, Telephone: 9251 7129, Facsimile: 9244 6581; research-ethics@deakin.edu.au
Please quote project number: STEC-30-2015-MOTAMED.

BAHAREH MOTAMED
PhD Student
School of Architecture and Built Environment
Deakin University
Email: bmotamed@deakin.edu.au
Mobile: 0405277934
PLAIN LANGUAGE STATEMENT

To: the Students completing the survey “STUDENTS EXPERIENCES IN RELATION TO THE USE OF COLOUR IN THE BUILT ENVIRONMENT.”

Date:

Full Project Title: Investigation of what informs architect’s colour choices in their design

Student Researcher: [PhD Candidate] Bahareh Motamed

Principal Researcher: [PhD Principal Supervisor] Associate Professor Dr Richard Tucker

Associate Researcher(s): [PhD Associate Supervisor] Dr Margaret Grose

This survey instrument is part of a wider project being investigated by PhD candidate Bahareh Motamed from the School of Architecture and Built Environment at Deakin University, under the supervision of Associate Professor Richard Tucker and Senior lecturer Margaret Grose.

This project investigates how much your personal and educational experiences have informed your understanding and use of colour in architecture. It aims ultimately to improve understanding and education around the use of colour in the built environment.

You are invited to complete the online survey of “EXPERIENCES IN RELATION TO THE USE OF COLOUR IN THE BUILT ENVIRONMENT.” The survey includes questions about the understanding and use of Colour by students and the role of colour study in architectural education. Permission for students to take part in this research has been given by your university. Participation in this research is completely voluntary and is anonymous. Therefore, your participation is not and cannot be linked to assessment or learning requirements within your unit/course of study. Your decision to take part or not will not affect any marks or grades for any assignment.

The study ultimately aims to enhance teaching and learning architecture and built environment programs by improving education in colour understanding and its use.

Your comments will remain anonymous throughout the PhD thesis, reports and publications developed out of this study.

Plain Language Statement Form to [Student]
[Project ID: STEC-30-2015-MOTAMED]
The overall time required for completing the survey is around 25-35 minutes. Accepting and answering implies your consent for the use of your information in the research. However, if you feel uncomfortable answering any questions, you can withdraw from the survey at any time until the survey is submitted. After submission, it is not possible to withdraw your information as the survey is anonymous and cannot be tracked back.

There is no risk involved for participants. Participation in this survey may be beneficial for students and architects who wish to express their views on the place and importance of colour in architectural education and how they expect to change it. The feedback in this study may inform future guidelines for improving built environment education and curriculum.

All data downloaded from the online questionnaire will be stored on a password-protected server at Deakin University for at least a period of 5 years after the final publication of the research outcomes. Data will also be stored on archival storage media that will be kept securely in the principal investigator's locked cabinet at Deakin University, Geelong Waterfront Campus, for a period of at least 5 years after the final publication of the research outcomes.

If you wish to access the results of the survey, or require further clarification regarding the survey and its procedures, you can contact Bahareh Motamed (contact details at the end of this form).

Approval to undertake this project has been given by the Human Ethics Advisory Group (HEAG), Faculty of Science Engineering and Built-Environment, Deakin University. If you have any complaints about any aspect of the project, the way it is being conducted or any questions about your rights as a research participant, then you may contact:

The Manager, Ethics and Biosafety, Deakin University, 221 Burwood Highway, Burwood Victoria 3125, Telephone: 9251 7129, Facsimile: 9244 6581; research-ethics@deakin.edu.au
Please quote project number: STEC-30-2015-MOTAMED.

BAHAREH MOTAMED
PhD Student
School of Architecture and Built Environment
Deakin University
Email: bmotamed@deakin.edu.au
Mobile: 0405277934