

Shifting Interpretations of Interiors and Buildings: The Impact of Colour

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Summary

The ability of a designer – for example, interior designer, architect, landscape architect, etc. – to design for a particular target group (user and/or clients) is potentially enhanced through more targeted studies relating colour *in situ*. The study outlined in this paper involved participant responses to five achromatic scenes of different built environments prior to viewing the same scenes in colour. Importantly, in this study the participants, who were young designers, came to realise that colour potentially holds the power to impact on the identity of an architectural form, an interior space and/or particular elements such as doorways, furniture settings, etc., as well as influence atmosphere. Prior to discussing the study, a selection of other research, which links colour to meaning and emotions, introduces how people understand and/or feel in relation to colour. For example, yellow is said to be connected to happiness; or red evokes feelings of anger. Secondly, the need for spatial designers to understand colour in context is raised. An overview of the study is then provided. It was found that the impact of colour includes a shift in perception of aspects such as its atmosphere and youthfulness. Through studio/class discussions it was also noted the predicted age of the place, the function, and in association, the potential users when colour was added (or deleted) were often challenged.

Introduction

Spatial designers are required to visualise and understand environments as complete long before the design is actually constructed and occupied. Therefore, the designer (architect, interior designer, landscape architect, etc.) needs to integrate the planning, form, structure and habitation with conditions of lighting, texture and colour over time and season. In educating such designers an ability to visualise, extrapolate and propose potential resolutions is required. Therefore, one of the key aspects to be addressed in this paper is: how can we ascertain the impact of colour on how we interpret the world in day-to-day situations?

Because it is difficult to remove other environmental elements (sound, odours, light or temperature) and the event (purpose, occasion or memories) from the way we understand and therefore experience place, the current study sought to build on previous research projects

that individually or collectively strive to study colour in relation to the built environment. A simple study was devised whereby the student designer was readily confronted by the potential impact of colour on meaning.

By investigating the shift in understanding of environments when viewing achromatic scenes prior to viewing the same scene in its natural colours the impact of colour was identified. A comparison was achieved by using visual imagery, in this case photography. A shift in environmental perception by participants was predicted. Such knowledge potentially enhances the ability of a designer to design for a particular target group, user and/or clients. This outcome is considered to be of value. In addition however, the participants in our study – young designers – were able to experience first hand and discuss how colour potentially manipulates the perceived identity of an architectural form, an interior space, and/or particular elements such as doorways, furniture settings, and the like. Through studio/class discussions it was noted that the predicted atmosphere, age of the place, the function and, in association, the potential users when colour was added (or deleted) were often challenged.

An overview of the study is introduced in the next section, with a brief outline of some examples of other studies that have linked colour to meaning and emotions. This establishes a link between colour and the way we understand and/or feel prior to discussing environmental interpretation in particular. A need for knowledge of colour in context is thereby highlighted. In response to this need, the achromatic/chromatic environmental study will then be described and discussed in light of the findings.

Background

Numerous authors report the meaning of various colour groups [1]; colours such as yellow are said to be connected to happiness [2]; or red evokes feelings of anger [3] or energy. For example, Ou *et al.* [4] studied colour emotions of single colours displayed on grey backgrounds and observed by different sub-groups. Cultural differences in responses were detected. In contrast to British observers, the Chinese preferred clean, fresh, or modern colours. The British considered active colours to be linked to ‘tenseness’, while the Chinese linked this emotion with hard, heavy, masculine or dirty colours. Four colour emotions were linked by Ou *et al.* to colour appearance: warm/cool (hue based), heavy/light (value based), active/passive (tone based) and hard/soft (chroma and lightness) [4].

Spatial properties of individual colours have been investigated and colour shown to influence a sense of enclosure and spaciousness [5–7]. In addition, the impact on moods (for example, calm or dynamic) has been explored. Lee and Lee [8] note that human emotional responses to colour may be unconscious (innate response); semiconscious (learned and routine) linked to factors such as cultural or climatic aspects; or a conscious response (preference and association based on personal experiences, fashion trends, current politics, and/or people’s personalities). Colour may also influence the interpretation of function. Typically, white is associated with sterility; or colours are associated with a function, i.e. fire trucks are fire-engine red.

Colour in combinations

However, knowledge of the impact of colour in relationships will be of value to designers in their practice. As Moretti and Lyons [9] state colour selectors, ‘rather than showing a small area of a single colour should allow the user to select, and see the effect of selecting, groups of

colours...'; 'colours are chosen out of context, and frequently do not appear as expected when applied'; and are, 'selected individually without regard of other colours'; '...and concepts of colour harmony are not widely understood...' [9].

The need for colour combinations has already been addressed by researchers such as Oberascher *et al.* [10] in relation to colour emotion; and by Kobayasi and his colleagues [11] in relation to meaning. The latter sought to identify the meaning of three colour relationships drawn from Japanese society; resultant guides to colour combinations and meanings are readily available [12]. However, Kobayashi's colour combination image scale is said to be limited [8] because it does not explain differences between various design concepts addressing real projects. Instead, colour combinations only include three colours and emotions are related to the scale.

Researchers identified by Lee and Lee [8] working with colour combinations and various design disciplines include: Korean company IRI Inc., who developed a tool based on objectified Koreans' emotions in response to colour combination for industrial design; Korean Fashion Color Association; Park and Jung, who developed a colour coordination support system for car interiors; and JIIA, who developed 'The Interior Color Coordination Dictionary' which integrated three psychological axes (mechanical–natural, light–dark and strong–mild) and emotional subgroups (including elegance, natural, Japanese, classic, dynamic, high-tech and casual); and Eun and Lee, who linked emotions of colour combinations to styles of clothing displays as well as respondent's residential location.

Colour combinations and environments

Generic descriptions are of little use for designers of the environments that we inhabit. Firstly, a colour such as yellow manifests itself in hundreds of subtle colour variations such as buttercup yellow, sunshine yellow, lemon yellow, banana spirit, golden yellow, etc. through the production of colour ranges or colour-ways for all the major industries such as paint, laminate and textile companies to name a few. Secondly, designers use colour in conjunction with space, form, materials and existing locations. Any colour that exists is in the company of others. It is also influenced by lighting conditions – even a white kitchen is never just white due to time of day and conditions such as shadows and reflections.

As reported previously [13], architects such as Barragan, Holl, Foster and Piano, use colour to express form, structure or services within single buildings, and thereby affect the way the façade or exterior draws attention and is interpreted. Internally, designers also use colour to express the planning logic, including way finding and orientation strategies [14].

In relation to colour combinations and interior design, Lee and Lee [8] demonstrated that with 'red-centred' and 'blue-centred' types of colour combinations, emotions shift to 'heavy and hard' area from 'soft and light' in varying dimensions as contrast in tone increases. Yellow-centred combinations were 'soft' moving only to the 'sober' as tone difference is greater, while grey-centred combinations did not seem to affect emotion. However, although Lee and Lee [8] use typical scenes of interior space (living rooms, bedrooms, kitchens, bathrooms) and simulated scenes of colour combinations, these were still stylised drawings depicted as flat coloured planes. The ambiguity and complexity of real life settings is missing. Studies by Guerin and co-workers [15,16] have utilised images of interiors in an attempt to understand preferences and meanings across cultural groupings. This involved six 'abstract colour palettes' representative of six 'pictures of an interior' where the palettes were computer-generated colour compositions of hue, value, chroma, contrast, overlapping and adjacencies. The findings of the latter study showed that preferences were culturally linked but the meanings were ambiguous.

In relation to environmental colour, designers and researchers have carried out studies of the impact of colour in natural settings. For example, Minah [17] has revealed the impact of colour on the readability of a city and how colour can impact on the skyline of large American cities. Others, such as Lenclos and Lenclos, have investigated colour usage which creates cultural distinctiveness [18]. Unique colour palettes can identify cities [18] or individual houses such as those of the Ndebele people in South Africa [19].

The principles involved in work by colourists and researchers such as those noted above have informed the authors' previous explorations with students into how colour can move alone, in combination and when placed in space, as well as in, in three-dimensional environments. The examples shown in Figure 1 illustrate some of the strategies employed previously.

The current study aims to bridge the issues raised by the research and these existing works by also looking at meaning and emotion in natural settings of the built environment; albeit controlled by using photography.

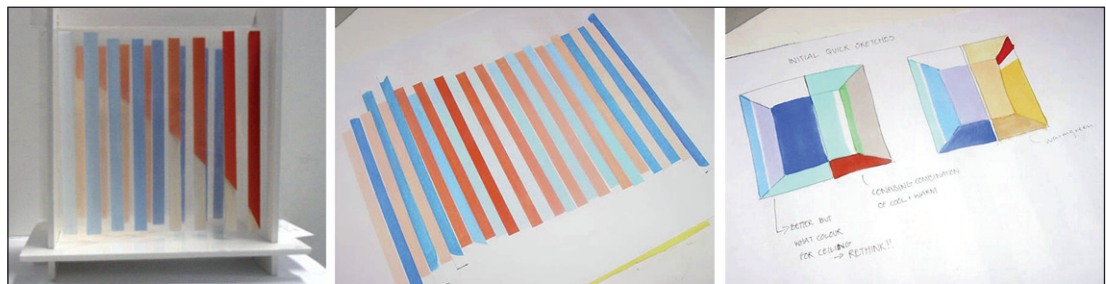


Figure 1 Examples of student exercises to explore colour spatial properties (student: K Coollum, 2002)

Experimental

The object of this study was to interrogate the impact of colour on the interpretation and experience of the world around us, particularly the built environment. In order to do this, participants were asked to critique a series of environments in terms of the colour relationships present, to describe the potential mood of a place, and to identify descriptors that are appropriate to particular settings. The settings were all built spaces but a range of images were selected for this pilot study, i.e. entrances, interiors and exteriors of buildings.

This investigation was carried out during two sequential years. The participants were university students drawn from a number of design disciplines, largely interior design students in the third semester of their undergraduate degree. Time was provided within the normal class activities within the Colour Studies Studio to undertake the exercise.

The exercise consisted of two stages:

- Stage 1: During the week prior to the studio, students were given an A4 PDF document containing a series of black and white images of the built environment to view via the unit's online teaching site. For each of the images (Figure 2), the students were asked to study the images and to record which adjectives provided as a list of descriptors described the environment as shown.
- Stage 2: In the class session, for each of the images, the students were then asked to record their response to the same photograph of environment but this time it was presented as a colour image. The same descriptors were provided.

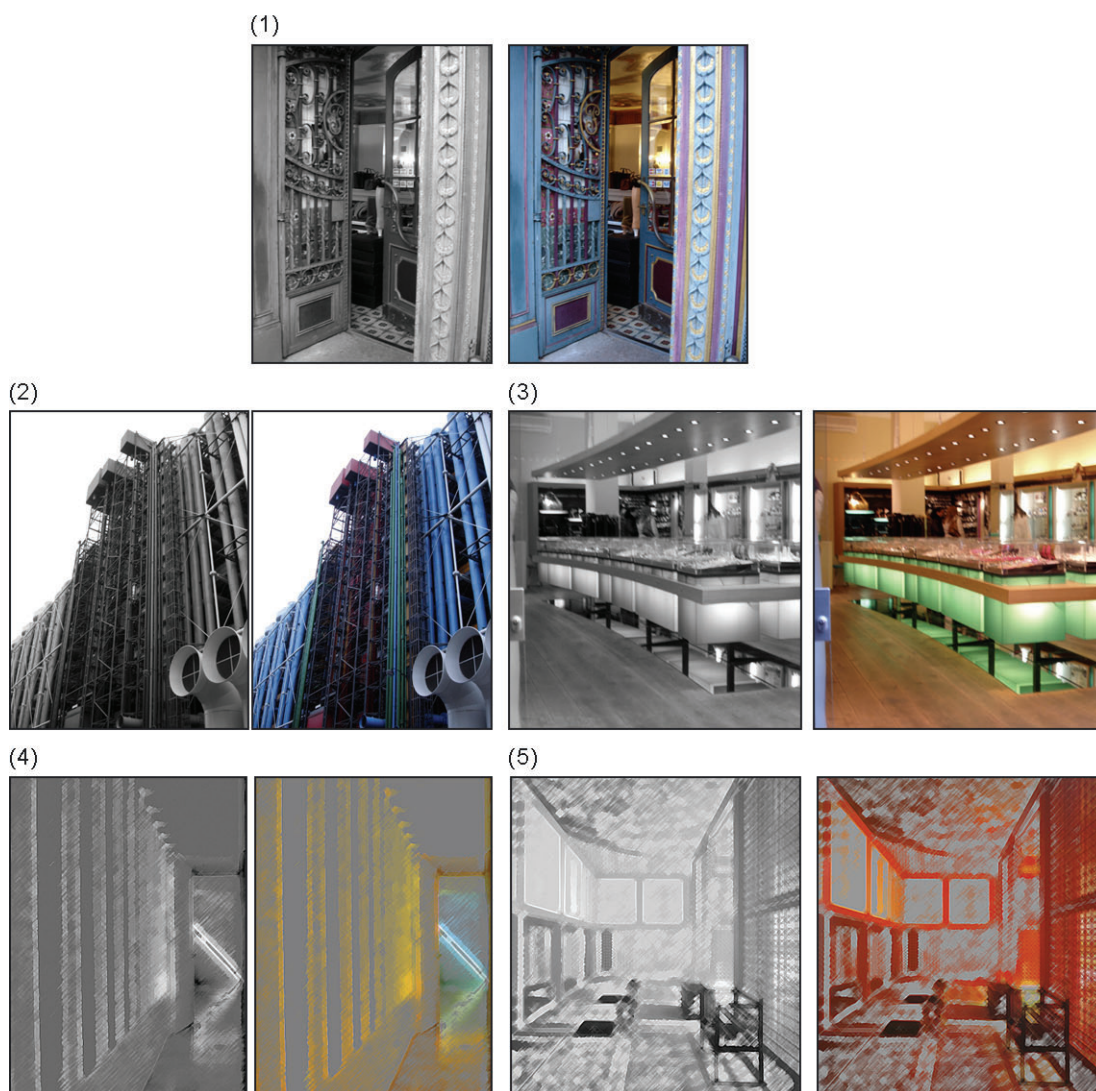


Figure 2 Images shown to the participants in (a) black and white and (b) colour format; image no.4 and no.5 are represented here as line drawings due to copyright restrictions

The descriptors have been chosen from the adjectives originally proposed by Osgood *et al.* [20] in their semantic differential studies in the 1950s. A number of these descriptors have been used by others as reported in the background to this study. The descriptors included: 'hard', 'soft', 'cool', 'warm', 'casual', 'elegant', 'chic', 'classic', 'dandy', 'modern', 'natural', 'formal', 'romantic', 'gorgeous', 'youthful', 'mature', 'domestic', 'clear', 'wild', 'dynamic', 'pretty' and 'calm'.

On completion of the exercise, small tutorial groups of four or five individuals were formed and they were asked to discuss the following questions:

- Did your interpretation of the place change? (for example, consider what type of place it seemed to be, who goes there, how is the atmosphere, how expensive is it, etc.);
- Identify similarities and differences;
- Consider how colour influenced your understandings;
- Identify two or three principles that you can conclude are involved in the interpretation of the built environment.

This formed the basis of a class discussion concerning the impact of colour on interpretation of place. Coloured images of an interior were provided to assist the discussion (Figure 3), which demonstrated design principles that the students needed to identify, such as such as unity, continuity, closure, direction, framing, contrast, order, etc. applied and evident through the use of colour.



Figure 3 Image of interiors used for class discussion, demonstrating design principles, which the students needed to identify such as such as unity, continuity, closure, direction, framing, contrast, order, etc. applied and evident through the use of colour

Results

The schemes depicted in the images in Figure 2 can be summarised as:

- Image no.1: analogous blue/blue–purple/purple, with decorative pattern;
- Image no.2: three contrasting pure hues blue, red and green, non-decorative;
- Image no.3: varying saturation of green plus honeyed timber, non-decorative;
- Image no.4: contrast of saturated yellow and contrasting blue, non-decorative; and
- Image no.5: monochromatic scheme of saturated reds, non-decorative.

The total number of possible respondents of the study was 69. Responses of these participants to each image and to each descriptor have been provided in a detailed table format in the former study [3]. However, collectively the total number of responses for those images which are black and white and for those images which are coloured vary from 380 to 643, as shown in Table 1.

Table 1 Statistically significantly different descriptors identified on comparing the achromatic and colour versions of each environment portrayed through photographs

Image no.	Black and White		Colour	
	Total responses	Statistically significant descriptors	Total responses	Statistically significant descriptors
1	567	Hard, elegant, classic, formal, mature	630	Soft, cool, casual, dandy, wild, dynamic, pretty, youthful
2	380	None	454	Cool, youthful
3	627	Cool	643	Warm, natural, wild, youthful
4	566	Cool, natural, clear, calm	570	Warm, romantic, wild, dynamic
5	570	Hard, cool, natural, elegant, formal, calm, mature	599	Soft, warm, dandy, wild, dynamic, youthful

Initial trends identified [3] indicated that there were shifts in how the participants interpreted the images provided. These were recorded as percentage changes for each descriptor and represented as histograms. The most significant descriptor variations (increase or decrease) per image were:

- Image no.1: soft, 83% increase; pretty, 66% increase; formal, 50% decrease; classic, 32% decrease; mature, 26% decrease
- Image no.2: cool, 70% increase; wild, 38% increase; modern, 24% increase
- Image no.3: warm, 80% increase; youthful, 44% increase; soft, 21% increase; clear, 20% decrease
- Image no.4: warm, 148% increase; clear, 45% decrease; formal, 26% increase
- Image no.5: dynamic, 93% increase; youthful, 93% increase; warm, 36% increase; modern, 17% increase.

In the current paper, the data are further analysed to ascertain which trends were statistically significant and the outcomes are discussed.

Shifts in interpretation per image

For each image the significant descriptors based on their Chi-square values (see later, Table 4) are identified in Table 1. The same image viewed as an achromatic image was described using descriptors that were significantly different when compared to the descriptors used when viewed in colour by the number of participants responding.

For example, image no.1 of a doorway to a boutique was described as hard in the black and white image, yet soft in the colour image. The same image, although described as cool in colour was not described as warm when viewed in black and white.

Impact of hue

This study indicates that colour does influence interpretation of environments in terms of its nature, atmosphere and image. The descriptors according to their aspects are classified in Table 2. 'Nature' refers to aspects such as warm/cool, hard/soft; 'atmosphere' refers to the mood, for example, calm/dynamic, formal/wild; and 'image' refers to aspects such as youthful/mature, elegant/dandy, etc.

However, the use of hue impacts in different ways and to different degrees depending on how it has been used. Two examples are provided in Figure 4 to demonstrate this outcome.

Cool is a descriptor significantly influenced by hue. However, the impact of the colour combination varies. The black and white version of image no.1 was considered to be less cool than images no.2 or no.5, for example. When hue was present, then it was interpreted as being cooler in images no.1 and no.2 yet less cool in images no.3, no.4 and no.5. It has to be noted that

Table 2 Descriptors according to their aspects

Nature	Atmosphere	Image
Soft, hard, cool, warm	Casual, elegant, classic, dandy, formal, wild, calm, dynamic, modern, clear, natural	Gorgeous, pretty, youthful, mature

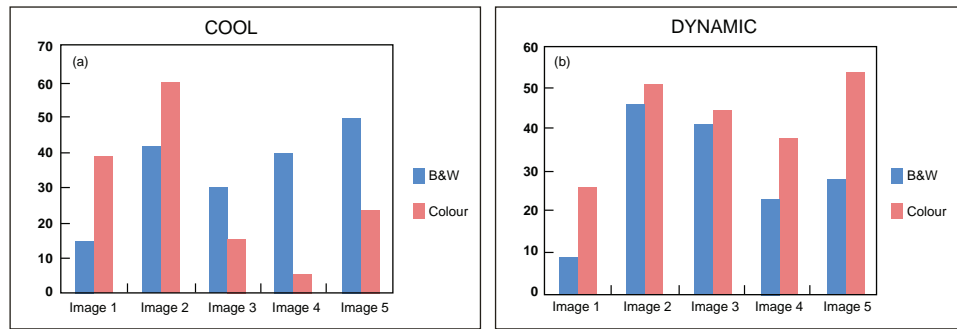


Figure 4 Numbers of participants describing black and white (B&W) images and then colour images for the terms: (a) cool and (b) dynamic



Figure 5 Example of student folio depicting record sheet, images, commentary and analysis indicating how the student engaged with the exercise (student: Peter Thomson, 2009)

two images described as the alternative variation for cool were not noted as being warmer as the authors had expected (see Table 1). Both images no.1 and no.2 were rated as cool in colour although temperature was not noted for the black and white version. Therefore descriptors, such as temperature, are not identified as relevant in all cases.

In contrast, the number of respondents selecting dynamic as a relevant descriptor increased with the addition of hue regardless of the original environment captured in the image. However, the difference was only significant in images no.1, no.4 and no.5 (Figure 5).

Meaning: what is the place?

Students described their interpretations of place and the role or impact of colour in their shifting understandings in a variety of ways. Colour impacted on what type of place the environment was.

For example, for image no.5 one student noted that the black and white image 'looks to portray a hallway in a hospital or aged care centre' whereas the coloured image 'appears to be a hallway in a residential home'. The yellow gives the overall feeling of happiness (student: Peter Thomson, 2009).

The impact of colour is demonstrated by the following quotes copied from students' folios.

Impact: colour can focus attention and influence understanding

‘My interpretation...was extremely different to that of the coloured. It was clear that when studying the black and white images I relied completely on the shapes of the structures within the building to form my opinion. This exercise really brought home the fact that colour can have an astounding impact on how we view the environment and can be used to emphasis structure. Principles used: proximity, closure, figure ground, continuity’ (student: LK, 2009).

Impact: colour can influence expectation of temperature and mood

‘The application of monochromatic red [scheme] tends to raise the temperature of the room compared to the black and white. The light source from the right creates shadows so the light and dark contrast is [more] mysterious and has a sense of depth [image no.4]; black and white: cool, modern, elegant, clear, formal, and calm place...pathway to the clinical space is clean with the...continuity of repeated light leading in that direction; colour: ...create an emotional shift from warm to cold...the light ray [directs]...to the left from warm, intimate space to a cold atmosphere [image no.5]’ (student: HYS, 2009).

Impact: colour placement or composition influences atmosphere

‘...Harmony is created by the repetitive use of colour and form which creates rhythm – the repetition gives formality; contrast of pure hue, saturation, [and/or] extension are present in all images...’ (student: EJS, 09).

Impact: colour can influence interpretation of users, identity and ambience

‘The mood or ambience in an environment and ordering principles are involved in the interpretation...by identifying the possible users...and analysing the organisation (foreground, proximity, etc.) one interprets the images. The ambience...is aided by lighting, visual harmony, clarity of line; identity is aided by modern-ness, busyness, hardness, etc., all of which are better perceived in colour’ (student: PC, 2009).

Overall influence of colour on interpretation

In addition to analysing individual images, the total impact of hue was also considered for all five images collectively. Of the 22 descriptors, only four were not significantly relevant, i.e. chic, casual, romantic and gorgeous. Therefore, compared to the black and white environments, coloured environments are: less hard, softer; less cool, warmer; more modern, less classic; less formal, less elegant, less natural, more dandy; less clear, wilder, more dynamic, less calm; more youthful, less mature; less domestic; prettier (Table 3 and Figure 6).

Table 3 Interpretation of the combined colour images compared to combined black and white (B&W) images

Image	Total responses	Nature	Atmosphere	Image
All images collectively	B&W: 2710 Colour: 2896	Less hard, softer, less cool, warmer	More modern, less classic, less formal, less elegant, less natural, more dandy, less clear, wilder, more dynamic, less calm, less domestic	More youthful, less mature, prettier

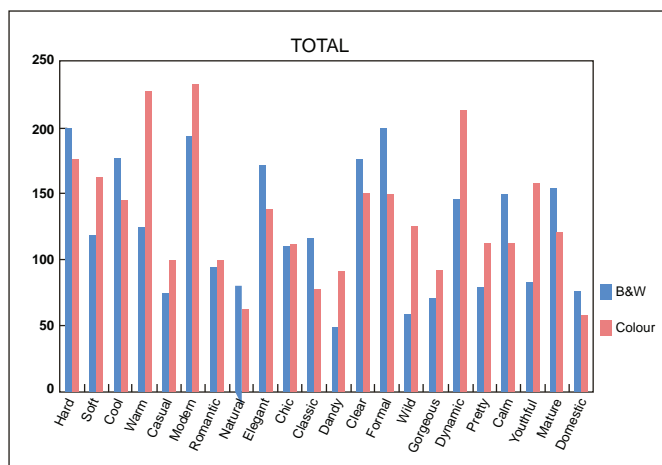


Figure 6 Total number of respondents for each descriptor across all images, black and white (B&W) and colour

When the descriptors with a high level of significance are compiled according to their Chi-square values, it is found that compared to the black and white environments, coloured environments showed changes as given in Table 4.

Table 4 Descriptors with a high level of significance compiled according to their Chi-square (χ^2) values (*P*)

<i>(P</i> < 0.001):
Less cool ($\chi^2 = 10.76$ with p-value = 0.001)
Less elegant ($\chi^2 = 10.66$ with p-value = 0.001)
Less mature ($\chi^2 = 11.53$ with p-value = 0.001)
Less calm ($\chi^2 = 11.54$ with p-value = 0.001)
Warmer ($\chi^2 = 50.42$ with p-value = 0.000)
Less classic ($\chi^2 = 14.08$ with p-value = 0.000)
More dandy ($\chi^2 = 14.3$ with p-value = 0.000)
Less formal ($\chi^2 = 19.24$ with p-value = 0.000)
Wilder ($\chi^2 = 40.82$ with p-value = 0.000)
More dynamic ($\chi^2 = 18.4$ with p-value = 0.000)
More youthful ($\chi^2 = 30.17$ with p-value = 0.000)
<i>(P</i> < 0.01):
Softer ($\chi^2 = 7.24$ with p-value = 0.007)
Less clear ($\chi^2 = 7.59$ with p-value = 0.006)
Less hard ($\chi^2 = 7.83$ with p-value = 0.005)
<i>(P</i> < 0.05):
Less natural ($\chi^2 = 3.89$ with p-value = 0.049)
More modern ($\chi^2 = 4.64$ with p-value = 0.031)
Less domestic ($\chi^2 = 4.77$ with p-value = 0.029)
Prettier ($\chi^2 = 5.41$ with p-value = 0.02)

Discussion and Implications for Future Research

The overall intention was to demonstrate to designers – in this case students – that colour does influence our understanding of environments. Through the qualitative and quantitative data this has been successful. In this study, five schemes were outlined for the scenes depicted in the images in Figure 2.

From the general class discussion, it was evident that image no.2 (i.e. the Pompidou Centre, France) was the least 'deceptive'. The strong verticality and level of contrast was understood as being an industrial site in grey. The addition of colour to highlight the services was seen to reinforce first impressions. The colour was said to make it more lively or playful as reflected by the descriptors recorded.

Image no.1 created the most discussion by the class. The original place in black and white image had been read as quite staid and to be a carved timber entry, reflecting a more classic or expensive shop. The decorative and colourful treatment in the colour image was described as being a complete surprise. Most people were amazed that it was a young fashion designer's boutique in Zurich.

For example, in his analysis of image no.1, one student noted that the black and white 'image appears to be an old shop somewhere in England. It appears cold and hard with a natural feel' whereas he thought the coloured image 'appears to be the entrance to a Turkish restaurant – rich in culture and romance'.

This study was limited to exploring whether colour impacted on the impression of the environment when compared to a black and white image of place. It has revealed that colour does have impact and its assessment in relation to places rather than as coloured chips or isolated combinations is important. The participants were able to gauge the impact and to note their own changes in understanding of the type of place and its possible functions through discussion and reflection.

An advantage of this study, was capturing the environment as it exists and not as a stylised drawing. The latter is often undertaken in an attempt to reduce the variables influencing the interpretation. However, as built environment designers, it is the integration and the complexity of context that is important.

The authors, as the next stage in this project, will repeat this study across three departments – interior design, architecture and industrial design – and three universities in conjunction with colleagues. As well as increasing the sample space, the proposed study will investigate different user groups and discipline foci in relation to the impact of colour on the interpretation of place.

In addition, three extensions could be made to develop this study further and increase the significance of the findings as well as applicability. Firstly, multiple images or videos of each setting could be used to form a deeper connection with the place, initially achromatic and then in true colour. Secondly, one image of the five (or each) could be manipulated to explore the impact of particular colour combinations depicted in the other four. Thirdly, the descriptors could be extended and/or ranked to give richer data. In addition, the qualitative discussions could be recorded to capture the way the images were analysed to determine their nature and the role that colour played in that process. The next logical step is to provide immersion in actual environments that can be viewed as if they are achromatic and then experienced in their 'true colours'. Technological aids could be designed to enable this comparison to be achieved. All would assist designers to understand the potential impact of colour on environmental interpretation.

Conclusions

This study's aim was simply to reinforce for design students that colour can influence their final designs in a profound manner. By dealing with settings that reflect interior design principles, students readily could engage with the exercise while being guided to look more deeply at their response to reveal how and why colour influenced their interpretation. Our students' responses indicated that, by challenging their preconceptions, this end was achieved.

Once a strong understanding of the impact and, therefore the need to use design to reinforce the designer's/their intention is achieved, then colour theory in relation to three dimensional design and user experience can be applied. Research introduced in the background section is purposefully not given to the participants. The exercise was quick and can be readily expanded (as outlined above), thereby, providing an accessible tool to design educators and for designers and students to trial the impact of their colour strategies.

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