The Effects of Colour in Work Environment:
A systematic review

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Abstract

In the work environment, colour is considered an important design element used to improve aesthetic qualities of the environment and for a company's branding. This paper reviews existing research on the effects of workplace colour on worker's mood, wellbeing and other work-related outcomes. In total 40 papers fitted the inclusion criteria and were included in the review. The results show a significant influence of colour on affect (e.g. mood, emotion), wellbeing (e.g. stress, comfort, wellbeing), and performance (e.g. productivity, performance, creativity). The review concludes with suggestions for further research.

1.0 Introduction

Colour is one of the elements that play a significant role in interior design, especially in the work environment. In the field of environmental psychology, colour is discussed as another environmental factor that has a great impact on human perception and behaviour. People feel stimulated by a warm colour, and a cool colour is calming. Workplace colour can affect the physiological response such as heart rate as well as anxiety and human comfort (Küller et al., 2009). Moreover, colour has an impact on work outcomes such as performance, productivity and creativity (Kwallek et al., 2007, Mehta & Zhu, 2009). It is often assumed that providing the right colour can have positive effects in the workplace. Moreover, individual colour preference is associated with the emotional response to the environment as well as behaviour in that environment. Therefore, understanding how colour can affect human perceptions and behaviour is essential for creating an efficient work environment.

2.0 Literature Review

The aim of this paper is to review the existing studies that examine the effects of colour in the work environment on human perceptions and behaviour, particularly regarding mood and wellbeing and work-related outcomes.
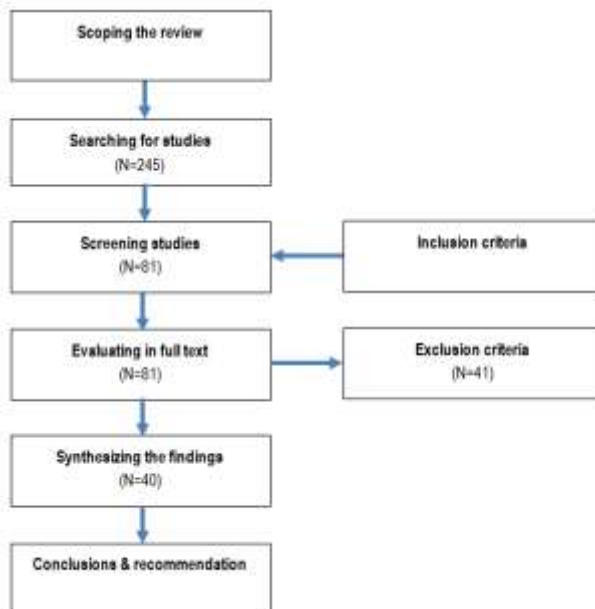
3.0 Methodology

Figure 1: Flow chart of systematic literature review process.

The procedure of the review included the following steps, as illustrated in Figure.1 • Scoping the review: In the field of psychology, social science, architecture

• Searching: The search was carried out in Scopus and Google Scholar databases.

• Screening process: Following the inclusion criteria, papers were limited to peer-reviewed academic literature in English language, published between 1990 and 2016.

• Evaluating the full text of selected papers: The following exclusion criteria were used to exclude articles, studies with no particular colour intervention and no outcomes, studies without a focus on colour and workplace design, descriptive literature, studies without a measurement instrument.

• Analysis and synthesis of the findings

• Conclusion

4. Results, Discussion, and Recommendation

Initially, 245 papers were retrieved from the databases. Among them, 81 papers were fit the inclusion criteria for this study. Subsequently, another 41 papers were excluded because they were not empirical studies, and 40 papers were selected for the final review. All studies are summarised in Table 1.

Most of the studies were conducted in the western regions. The cross-cultural studies were mostly conducted across Europe and Asia. Three aspects of colour were studied: hue, saturation and brightness. The majority of the studies focused on studying warm versus cool colours. Warm colours were usually red, orange, yellow, and cool colours were most often blue and green.

The evidence from 40 studies identified that colour of work environment has significant effects on the human in three categories: mood and emotion, physiology and wellbeing, and work-related   outcomes.

Table 1: Categories of study design and the reported effects of colour in the work environment

| | | | | | | Assessments | | | |
	Authors	Study Design	Methods	Participants	Colour sample	Psychology	Physiology	Outcome	Preference
1	Abbas et al. (2006)	Experimental	Laboratory, ECG	15 students; Australia	Red, blue, green		X		
2	Al-Rasheed (2015)	Experimental (Cross-Cultural)	Experimental room	109 Students; England, Saudi Arabia	Red, pink, Yellow-red, red-pink, green, blue-green, green-yellow				X
3	Bakker et al. (2013)	Experimental	Real meeting rooms, questionnaires	52 employees; The Netherlands	Red, blue		X	X	
4	Baniani & Yamamoto (2015)	Experimental (Cross-	Drawing, Painting,	319 students; Iran, Japan,	Colour schemes				X

		Cultural)	Questionnaires	Foreign				
5	Ceylan et al. (2008)	Experimental	25 photographs	60 managers, Turkey	Yellow, orange, pink, green, red, red violet, blue, blue violet			X
6	Dijkstra (2008)	Experimental	Laboratory, Stress Arousal Checklist	89 students; Turkey	Green, Orange, white		X	
7	Dul et al. (2011)	Survey	Creative Personality Scale	274 workers; The Netherlands	Warm colours , cool colours			X
8	Elliot et al. (2007)	Experimental (Cross-Cultural)	Laboratory & classroom IQ test, task	282 students; USA, Germany	Red, green black, white, gray	X		X
9	Franz (2006)	Experimental	Web experiment	125 participants; Germany	16 hue, 4 saturation & brightness levels.	X		
10	Gao et al. (2007)	Experimental (Cross-Cultural)	Experimental room	440 students; Hong Kong, Japan, Thailand, Taiwan, Italy, Spain, Sweden	214 colours	X		
11	Gyu & Park (2013)	Experimental (Cross-Cultural)	Model	92 participants, USA, Korea	Red, yellow, green, blue, purple, white			X
12	Hidayetoglu et al. (2012)	Experimental	9 pictures, 9 videos	102 students; Turkey	Red, blue grey, with low & high brightness	X		
13	Kamaruzzaman et al. (2010)	Survey	Questionnaires, interviews	105 employees; Malaysia	Colour schemes	X		X X
14	Kaya et al. (2004)	Experimental	Experimental room	98 students; USA	Red, yellow, green, blue, purple, white, gray, black 5 intermediate hues:	X		
15	Kurt & Osueke (2014)	Survey	Questionnaires, interviews	490 students, staffs; Cyprus	Colour schemes	X		
16	Kwallek & Lewis (1990)	Experimental	Experimental room, tests, questionnaires	675 students; USA	Red, green, white	X		X X
17	Kwallek et al. (1996)	Experimental	Experimental room, tests, questionnaires	90 workers; USA	Red, orange, yellow, blue, green, purple, white, gray, beige	X		X X

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18	Kwallek et al. (1997)	Experimental	Experimental room, tests, questionnaires	90 workers; USA	Red, blue-green, white	X		X	X
19	Kwallek et al. (2007)	Experimental	Experimental room Questionnaires	90 workers; USA	Red, blue-green, white			X	
20	Küller et al. (2006)	Experimental (Cross-Cultural)	Real work environments, Questionnaires	998 employees; Argentina, Saudi Arabia, Sweden, UK	Monotonous, neutral, colourful	X			
21	Küller et al. (2009)	Experimental	Experimental room, EEG, EKG, interview, questionnaires	57 students; Sweden	Red, blue Colourful, gray	X	X	X	
22	Lengen (2015)	Experimental	Painting, interview	20 participants; Switzerland	Blue, green, grey, white		X		
23	Lebedkova et al. (2012)	Experimental	Experimental room, Questionnaires	10 participants, Russia	Orange, ochre, blue & yellow, green, dark blue		X	X	
24	Liu et al. (2014)	Experimental	Questionnaires	75 patients; China	27 colours	X			X
25	Manav (2007)	Experimental	Experimental room, questionnaires	20 students, Turkey	Light blue and light yellow	X			
26	McCoy and Evans (2002)	Experimental	photographs	60 students; USA	Red, yellow, red-violet, green, blue, blue violet			X	
27	Mehta & Zhu (2009)	Experimental	Computer	666 participants; Canada	Red, blue			X	
28	Ou et al. (2012)	Experimental (Cross-Cultural)	Experimental room	223 participants; UK, Taiwan, France, Iran Germany, Spain, Sweden, Argentina	190 colour pairs	X			X
29	Öztürk et al. (2012)	Experimental	Experimental room	60 staffs; Turkey	Achromatic, Chromatic	X		X	
30	Park & Guerin (2002)	Experimental (Cross-Cultural)	Experimental room, questionnaires	425 students; USA, England, Korea, Japan	Hue, value, chroma,				X
31	Park (2009)	Experimental	Model	153 participants; USA	Red, yellow, green, blue, purple, white, 9 brightness & saturation				X
32	Poursafar et al. (2016)	Survey (Cross-	Questionnaires	202 architects; Iran, India	Colour schemes			X	X

		Cultural)						
33	Saito (1996)	Survey (Cross-Cultural)	Colour chart, questionnaires.	1600 participants, Japan, Korea, Taiwan	62 chromatic 3 achromatic			X
34	Sorokowski et al. (2014)	Survey (Cross-Cultural)	Colour chart, interviews	308 participants; Papua, Poland	Red, orange, yellow, green, blue, purple & 6 colours in-between			X
35	Stone & English (1998)	Experimental	Experimental room, MAACL, questionnaires	122 students; USA	Red, blue	X	X	
36	Stone (2001)	Experimental	Experimental room, MAACL, questionnaires	144 students; USA	Red, blue, white	X	X	
37	Stone (2003)	Experimental	Experimental room, MAACL, questionnaires	128 students; USA	Red, blue	X	X	
38	Taylor, Clifford and Flanklin (2013)	Experimental (Cross-Cultural)	Computer	95 participants; Namibia, England	Red, orange, yellow, green, cyan, blue, purple & 8 saturation			X
39	Valdez & Mehrabian (1994)	Experimental	Color cards, PAD scales	396 students; USA	Red, yellow, green, blue, purple, red-purple, yellow-red, green-yellow, blue-green, purple-blue	X		X
40	Yildirim et al. (2015)	Survey	Questionnaires	909 students; Turkey	Blue, pink, cream	X		
Total						21	6	18	16

4.1 Colour preference

In total 16 studies were included that examined colour preferences. Most of the studies were cross-cultural study. Blue and green are consistently found to be the most favourite colours (Kamaruzzaman et al., 2010; Kwallek et al., 1997; Liu et al., 2014; Park, 2009; Poursafar et al., 2016; Valdez & Mehrabian, 1994). However, colour preference is not universal (Taylor, Clifford and Flanklin, 2013) and are influenced by differences in age, gender, cultural aspect (Park & Guerin, 2002; Saito, 1996; Sorokowski et al., 2014), background and experience (Baniani & Yamamoto, 2015).

In the workplace, the preference of colours can influence on worker's mood, wellbeing

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and performance. (Kamaruzzaman et al., 2010; Poursafar et al., 2016). White is the most favourite neutral colour (Poursafar et al., 2016) and workers prefer to work in a white environment (Kwallek & Lewis, 1990; Kwallek et al.,1996).

4.2 Mood and emotion
In total 21 studies focused on mood and emotion. Most of the studies used a subjective measure of mood such as The Multiple Affect Adjective Check List (MAACL); The PAD (Pleasure, Arousal, and Dominance).

The emotional responses to colour are related to the meaning of colours. Green evokes the most positive emotional responses and is associated with relaxation, and happiness (Kaya et al., 2004). A cross-cultural study found positive emotional status when working in the colourful environment. The good colour scheme will enhance overall mood of worker (Küller et al., 2006). Blue is perceived more positive than red in the open-plan environment (Stone, 2001) but other studies suggest it can also be perceived as depressive (Stone & English, 1998), and less attractive (Yildirim et al., 2015). The red environment can be perceived as stimulating as well as distracting (Kwallek & Lewis, 1990; Kwallek et al., 1997). White walls tend to be perceived boring and uninteresting (Kurt & Osueke, 2014).

4.3 Physiology and wellbeing
In total six studies focused on health outcomes using physiological measures. This included Electroencephalogram (EEG) and electrocardiogram (EKG or ECG) to measure brain's activity and heart rate variation.

Some colours have a greater impact on heart rate than others (Abbas et al., 2006). Working in the red or colourful room with visual complexity put the brain into a more exciting state, caused the slowing of the heart rate and overload. Blue was reported to have a drowsy and sleepy effect (Küller et al., 2009). Good workplace colour combinations can have a positive influence on visual working capacity and increase comfort (Lebedkova et al., 2012). Perception and experience in blue and green space are associated with a sense of wellbeing.

4.4 Work-related outcomes
In this section, 18 studies regarding the effects of workplace colour on work-related outcomes were divided into the following main topics: performance, productivity and creativity.

4.4.1 Performance
In total 11 studies on colour and performance were included which were all conducted in laboratory settings. A colourful workplace tended to enhance performance more than a workplace with an achromatic scheme (Öztürk et al., 2012). Some colour combinations increase a positive influence on visual working performance; speed of work and accuracy (Lebedkova et al., 2012). Working in the white environment resulted in the most errors being made (Kwallek & Lewis, 1990; Kwallek et al., 1996). Red was reported to have both negative and positive effect (Elliot et al., 2007; Kwallek et al., 1996; Küller et al., 2009).

The level of performance depended on the type of task and task demand (Stone & English, 1998, Stone, 2001, Stone, 2003). Red enhances cognitive task performance

whereas working in the blue enhances creative task performance (Mehta & Zhu, 2009).

4.4.2 Productivity
Four studies reported the effect of workplace colour on human's productivity. Neutral colours, cool blue colours (Kamaruzzaman et al., 2010) as well as a balance between warm and cool colours can enhance productivity. By contrast, cool colours in the context of architectural office were found to reduce productivity (Poursafar et al., 2016). Interestingly, one study conducted in a real life work situation reported no effect of colour on perceived productivity (Bakker et al., 2013).

4.4.3 Creativity
Four studies showed that workplace colour had the influence on creativity. Cool colours have a significant negative effect on creativity potential (McCoy and Evans, 2002). In contrast, Ceylan et al. (2008) reported that the cool workplace colours enhanced creativity, supporting the managers to think and generate ideas. Positive effects may be because cool colours are calming whereas warm colours are overstimulating making it difficult for people to concentrate.

4.5 Discussions
It is very clear that workplace colour has the significant effect on mood, physiology and wellbeing and work-related outcomes. Both consistency and contradictory results were found. The individual difference regarding culture, gender, age and background may influence the perception of workplace colour and colour preferences. Studies with students in hypothetical laboratory studies may not be comparable to experiences in the actual work environment. Moreover, the existing research almost focuses on a limited number of colours, primarily red, blue and green. There is very little research which examines colour combinations which may be more representative for workplace colour in a real everyday work environment.

5.0 Conclusion
Strong evidence was established that colour in work environment plays a significant role in human's perception and behaviour especially mood, wellbeing and performance. The use of colour in the workplace can enhance positive mood, contribute the sense of wellbeing and lead to a positive outcome. Understanding the maximum dimension of how difference workplace colours influence humans is essential. More research is needed to examine the following factors: the combination of colour, the context of the work environment, cross-cultural factors and individual differences.

Acknowledgement

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