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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.

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Keywords: Colour perception; Colour psychology; Effect of colour; Work environment

1. Introduction

Colour is one of the elements that play an important role in interior design, especially in the work environment. Colour is used in the workplace to provide aesthetic enjoyment to workers and visitors as well as to express company's brand identity. In the field of environmental psychology, colour is discussed as another environmental factor that has a great impact on human perception and behaviour. Colour in the workplace influences psychological response in term of mood and emotional state. 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 are associated with the emotional response to the environment as well as behaviour in that

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environment. Therefore, understanding how colour can affect human perceptions and behaviour is essential for creating an effective work environment.

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.

2. Conceptual framework

Base on a model of aesthetic response to building attributes developed by Nasar (1994), a framework is defined and developed. This conceptual framework is illustrated in Fig.1 and describes how colour in the work environment may effect human perceptions, affect and cognition.

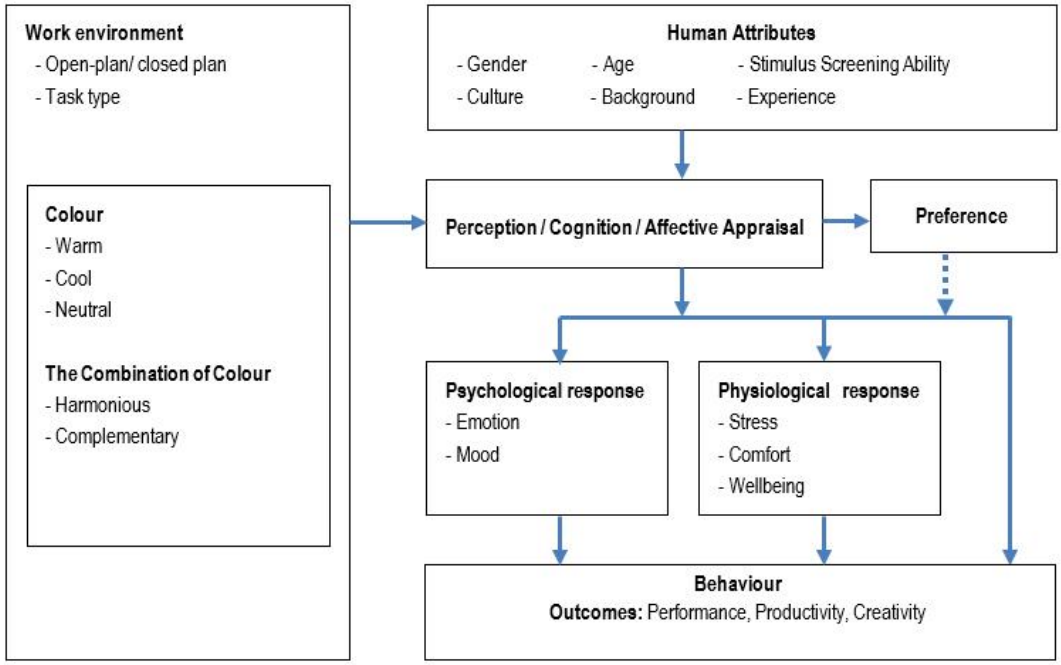

Fig. 1. The effects of colour in work environment, based on the work of Nasar (1994).

3. Methods

The procedure of the review included the following steps, as illustrated in Fig.2.

- Scoping the review: In the field of Psychology, Social science, architecture
- Searching: The search was carried out in Scopus and Google Scholar databases. Keywords and phrases related to colour, effects of colour and the work environment were used to search for titles and abstracts of possible literature.
- Screening process: Following the inclusion criteria, papers were limited to peer-reviewed academic literature in English language, papers were published between 1990 and 2016 because the revolution that started changing the workplace has spread in the early 1990s.

- Evaluating the full text of selected papers: The following exclusion criteria were used to exclude papers, studies with no specific colour intervention and no outcomes, studies without focus on colour and workplace design, descriptive literatures, studies without a measurement tool of instrument.
- Analysis and synthesis of the findings
- Conclusion

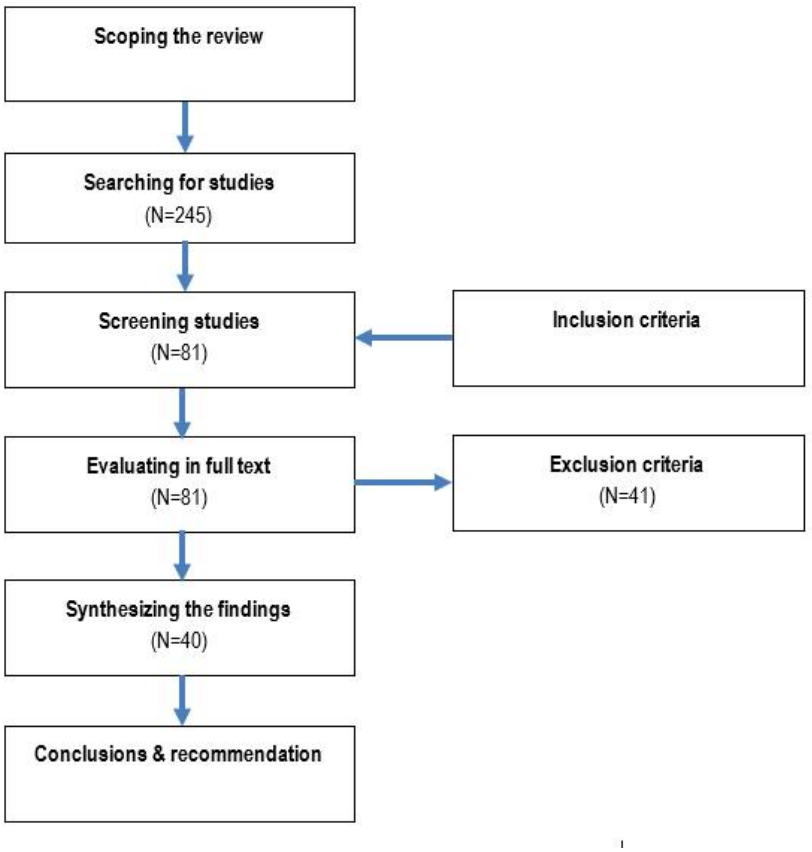

Fig. 2. Flow chart of systematic literature review process.

4. Results

Initially 245 papers were retrieved from the databases. Among them, 81 papers were fit the inclusion criteria for this study. Their full texts were accessed and evaluated. 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.

The 40 studies addressed a variety of effects of colour on human perceptions and behaviour. Most of the studies were conducted in the western regions: Europe and America. 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 human in three categories: mood and emotion, stress and wellbeing, and cognition and performance.

Table 1. Categories of study design and the reported effects of colour in 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, blue-green, 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- Cultural)	Drawing, Painting, Questionnaire	319 students; Iran, Japan, Foreign	Colour schemes				X
5	Ceylan et al. (2008)	Experimental	25 photographs	60 managers, Turkey	Yellow, orange, pink, red, red violet, green, 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, questionnaire	675 students; USA	Red, green, white	X		X	X
17	Kwallek et al. (1996)	Experimental	Experimental room, tests, questionnaire	90 workers; USA	Red, orange, yellow, blue, green, purple, white, gray, beige	X		X	X
18	Kwallek et al. (1997)	Experimental	Experimental room. tests, questionnaire	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 Questionnaire	10 participants, Russia	Orange, ochre, blue & yellow, green, dark blue		X	X	
24	Liu et al. (2014)	Experimental	Questionnaire	75 patients; China	27 colours	X			X
25	Manav (2007)	Experimental	Experimental room, questionnaire	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, questionnaire	425 students; USA, England, Korea, Japan	Hue, value, chroma, value contrast, chroma contrast.				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- Cultural)	Questionnaires	202 architects; Iran, India	Colour schemes			X	X
33	Saito (1996)	Survey (Cross- Cultural)	Colour chart, questionnaire.	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, questionnaire	122 students; USA	Red, blue	X		X	
36	Stone (2001)	Experimental	Experimental room, MAACL, questionnaire.	144 students; USA	Red, blue, white	X		X	
37	Stone (2003)	Experimental	Experimental room, MAACL, questionnaire	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	Questionnaire	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. The results provide the variation of factors that can influence individual preference. 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 are not universal (Taylor, Clifford and Flanklin, 2013) and are influenced by differences in age, gender, cultural aspect (Saito, 1996), background and experience (Baniani &

Yamamoto, 2015). Men and women tend to prefer different colours. Although men from different cultures are more similar in their preference than women (Al-Rasheed, 2015; Sorokowski et al. (2014). People in eastern and western cultures differ in their preferences (Park & Guerin, 2002; Sorokowski et al., 2014). Asians liked white as it is associated with religious aspects (Park & Park, 2013, Saito, 1996).

In the workplace, the preference of colours can influence on worker's mood, wellbeing 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) although it might also be perceived dull and boring (Kamaruzzaman et al., 2010).

4.2 Mood and emotion

In total 21 studies focused on mood and emotion. Most of the studies used a subjective measure of mood. This included the use of instruments such as The Multiple Affect Adjective Check List (MAACL); The PAD (Pleasure-displeasure, Arousal-non-arousal, and Dominance-submissiveness) where respondents are asked to report their mood on a semantic differential scale.

The reviewed evidence demonstrates that emotional responses to colour are related to the meaning of colours. Green evokes the most positive emotional responses and is associated with relaxation, calmness, and happiness (Kaya et al., 2004). Red is associated with danger; thus the colour evoked avoidance behavioural response (Elliot et al., 2007). There is a consistency in such emotion response in warm and cool colours (Gao et al., 2007).

Workplace colour had a both positive and negative effect on emotion and mood of human. A cross-cultural study found positive emotional status when working in the colourful work 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). 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 6 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.

Colour in work environment had a significant influence on the physiology of human. 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 is associated with a sense of wellbeing. Green is associated with recreation and freshness (Lengen, 2015) and has a reducing stress effect on low stimulus screener person (Dijkstra, 2008).

4.4 Work-related outcomes or cognition

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. Participants performed a task and completed the questionnaires. The studies agreed that environmental colour influenced performance though some of the results were contradictory.

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, accuracy and absence of error (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). Colour also affected performance through negative mood associated with red (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 and due to associations with calmness and comfort. By contrast, cool colours in the context of architectural office were found to reduce productivity (Poursafar et al., 2016). The different effects may be depended on differences in individuals' stimulus screening ability (Kwallek et al., 2007). Interestingly, one study conducted in a real life work situation reported no effect of colour on perceived productivity. The real working process may be too complicated to measure colour influences (Bakker et al., 2013).

4.4.3 Creativity

Four studies showed that workplace colour had influence on creativity. Cool and warm colours are related to creative performance (Dul et al.,2011). 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 and relaxing whereas warm colours are overstimulating making it difficult for people to concentrate. However, one study of Küller et al. (2009) reported that room colours had no effect on creativity.

5. Discussions

This review investigates and discusses the effects of colour in the work environment on human's perceptions, mood, wellbeing and cognition from 40 papers. It is very clear that workplace colour has the significant effect on mood and physiological outcomes. Both consistency and contradictory results were found (e.g. red is arousing and blue calming and preferred). There are several possible reasons for the conflicting findings. Firstly, individual difference regarding culture, gender, age and background may influence the perception of workplace colour and colour preferences. The preference of colour is associated with a variation of effects as well. Furthermore, some of the studies use students as test subjects instead of the real employee. Studies with students in hypothetical laboratory studies may not be comparable to experiences in the actual work environment. The review also found that existing research almost focuses on a limited number of colours, primarily red, blue and green, which they compare against each other. There is very little research which examines colour combinations which may be more representative for workplace colour in a real every day work environment.

6. Conclusions

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 be examine the following factors: the combination of colour, context of the work environment, cross-cultural factors and individual differences.

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