Effects of Coloured Lighting on Judgement of Emotional Expression

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Summary

The effects of environmental colours upon cognitive judgement were examined. Subjects were divided into three lighting conditions; white, red and blue. The individuals listened to short conversations between a man and a woman under the assigned colour lighting, and judged the degree of emotional expression of talkers for each conversation. Half of the conversations included emotional words in their scripts (E condition), and the other half did not (N condition). After finishing this task, subjects were asked to estimate the personality of talkers based on the impression of all conversations. The results showed that subjects in the red lighting condition judged talkers to be more emotional than subjects in the white lighting condition. This difference was found only in the N condition in which conversations did not include emotional words and the mean judgement score for emotional expression was lower than the E condition. As for the estimated personality of talkers, there were no significant differences among lighting conditions. These results showed both potentiality and limitation of the effect of environmental colours.

Introduction

The psychological effects of colours are intriguing topics for both researchers and designers. A number of empirical studies from the early twentieth century [1–3] suggested that two categories could be classified in terms of the treatment of colour, i.e. visual stimulus or environmental factors. In general, studies that treat colour as a visual stimulus collect subjects' direct responses (e.g. impression rating, spontaneous reaction, etc.) to the presented colours [3–7], whereas studies that treat colour as an environmental factor examine the indirect effects of colours upon unrelated behaviours or task performances [8–10]. Thus far, the indirect effects of environmental colours have not been studied as much as the direct effects of stimulus colours. From a practical point of view, however, the effects of environmental colours should be more important than those of stimulus colours, because it is rather unusual only to see coloured paper or to stay in a room illuminated with colour without doing any other tasks.

In a previous study from this author, the effects of coloured lighting (red, green, blue and yellow) upon performance of the Kraepelin-type addition task were investigated [11]. It was assumed that, if certain colours produced some psychological effects as generally believed (e.g. blue makes people more relaxed and concentrated), task performances such as productivity,

stability and accuracy could be influenced by the coloured lighting. However, any expected results on the task performances were not found to be clear. Moreover, time estimation of the task period, and subjects' physical and mental fatigue, sleepiness and concentration, were not influenced by the colours. The only evident result was the impression of colour lightings themselves; red was 'cheerful,' blue was 'refined,' and green and yellow were 'calm.'

The possible reason for failure in obtaining clear results in that study could simply be a mistaken choice of the task to be used; that is, such a simple task as a successive addition might have been inappropriate for an exact evaluation of possible effects of the environmental colours. In this kind of task, subjects might have been able to devote themselves to the required work regardless of the strong perceptual or cognitive impression given by the colour lightings. Consequently, in the present study, I used a new task of emotional-expression judgement of talkers on short conversation, and tried to re-examine the psychological effects of the environmental colours from the viewpoint of higher-order cognitive activities.

Methods

Subjects

The individuals who took part in this study were 145 undergraduate students (classed as the 'subjects'). They were divided into three groups each of which was assigned to one of three coloured lighting conditions; white, red and blue. All subjects were tested individually.

Instruments

The experimental room was illuminated either by colour beam bulbs (National BF110V 80W-R, B) or white fluorescent lamps with illuminance of 440 lx. Chromaticity of the top surface of a table in front of the subject, which was covered with white paper, was $x = 0.668$, $y = 0.320$ when illuminated red, and $x = 0.140$, $y = 0.201$ when illuminated blue (Figure 1).

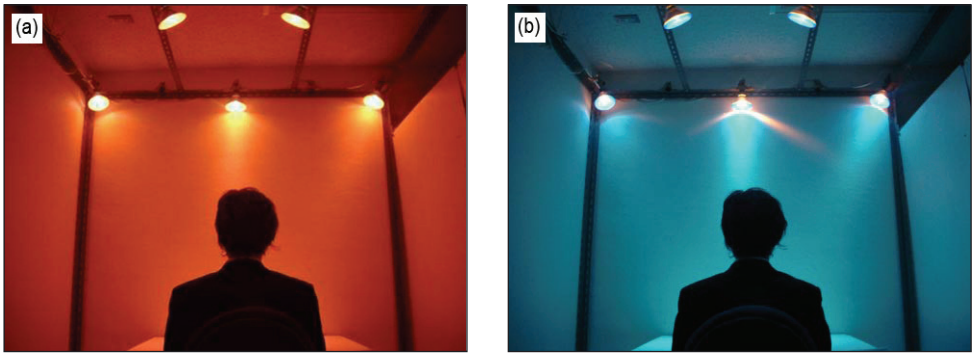

Figure 1 Lighting conditions: (a) red and (b) blue

Tasks and procedure

Subjects were instructed to listen to 20 short conversations between a man and a woman, and to judge the degree of emotional expression of talkers during each conversation by stating a number from 0 (the lowest) to 100 (the highest). A script of each conversation consisted of four lines of several words with each person talking twice. Ten of them included emotional words

such as 'shut up!' (emotional condition; E), and the other ten did not (neutral condition; N). Samples of the scripts are as follows:

– Man (M): *What day is it today?* Woman (W): *It's Wednesday.* M: *Wednesday, Thursday, Friday…oh, another three days!* W: *Do you have anything on Saturday?* (one in N condition)
– W: *Oh, it's raining!* M: *Really? I don't have an umbrella.* W: What? *Oh, you're so useless.* M: *You don't too!* (one in E condition with 'useless' as an emotional word)

These conversations were successively played back, at an interval of 7 s, by a cassette tape recorder behind the subject. Subjects were instructed not to close their eyes during the task. The meaning of the coloured lighting was camouflaged by a dummy instruction which said, 'It is for the subsequent visual experiment that requires you to be pre-adapted to the colour illumination.' (This experiment was not actually conducted.)

After finishing the emotional–expression judgement task on 20 conversations, subjects were asked to estimate the personality of the man talker and that of the woman talker by responding to 20 adjective-pair scales such as 'positive–negative,' 'kind–unkind' and 'patient–impatient.' The full list of items is given in Table 1.

Table 1 Factor analysis for the data of personality estimation of talkers

	I: Positiveness	II: Friendliness	III: Sensibleness	Communality
Energetic	0.814	–0.040	0.073	0.669
Cheerful	0.717	–0.008	–0.203	0.555
Positive	0.713	0.042	–0.073	0.515
Confident	0.648	–0.245	0.059	0.483
Friendly	0.637	0.445	–0.011	0.604
Sociable	0.625	0.168	–0.145	0.440
Agreeable	0.544	0.498	0.117	0.558
Stately	0.469	0.011	0.076	0.226
Affable	0.456	0.332	–0.089	0.326
Not impudent	–0.258	0.722	0.097	0.597
Good-natured	0.030	0.660	0.144	0.457
Patient	–0.228	0.622	0.089	0.446
Kind	0.196	0.575	–0.029	0.370
Broad-minded	0.128	0.561	0.140	0.351
Lovely	0.273	0.526	0.209	0.395
Careful	–0.131	–0.017	0.737	0.561
Sensible	0.155	0.223	0.547	0.373
Grave	–0.152	0.131	0.546	0.338
Shy	–0.124	0.034	0.478	0.245
Responsible	0.216	0.104	0.477	0.285
Eigenvalue	*4.880*	*3.499*	*2.042*	

Results

In each subject, emotional–expression judgement scores were averaged separately for N and E conditions. Figure 2 shows mean judgement scores in each condition. An analysis of variance revealed a significant main effect of the script condition ($F = 77.99$; $df = 1,134$; $p < 0.001$) and a significant interaction between the script condition and the lighting condition ($F = 3.32$; $df = 2,134$; $p < 0.05$) (where the F value is a statistical term, df is the degree of freedom and p is the probability). A post hoc analysis revealed that judgement score for N scripts in the red lighting condition was significantly higher than that in the white lighting condition.

Next, the data for personality estimation was subjected to a factor analysis (principal factor analysis followed by the Varimax rotation). Three factors were obtained and labelled as 'positiveness,' 'friendliness' and 'sensibleness,' respectively (Table 1). Then, the mean score for each factor was compared among lighting conditions separately for the man talker and for the woman talker. No significant difference was found in any comparisons (Figure 3).

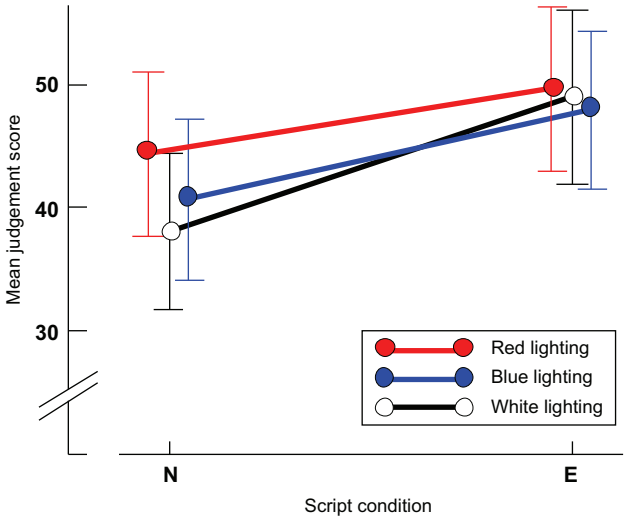

Figure 2 Mean judgement scores in each condition (error bars indicate standard deviations)

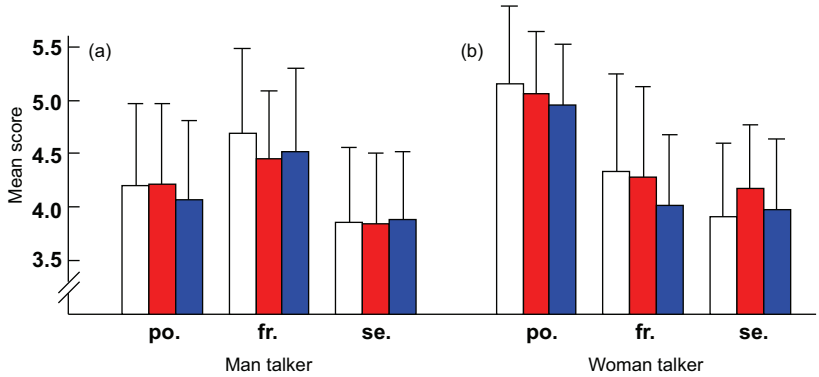

Figure 3 Mean scores in the personality estimation of (a) the man talker and (b) the woman talker in terms of positiveness (po.), friendliness (fr.) and sensibleness (se.) (the colour of each bar indicates the coloured lighting condition; error bars indicate standard deviations)

Discussion

Subjects who heard the conversations under the red lighting judged that talkers were more emotional than those who heard the same conversations under the white lighting. The

red lighting should have produced such an effect by biasing the subjects' frame of mind. As mentioned above, in the previous study (which employed the same colour lightings as the present study) the red lighting was shown to produce a cheerful and active impression [11]. Thus, it can be supposed that subjects in the red lighting condition in this experiment unconsciously modulated their inner criterion of judgement to be accordant with the perceptual impression of the colour illuminating the room. However, such an effect was found only in N condition. In other words, when the explicit emotional words were included in the conversation, the effects of colour lighting disappeared. The effects of the environmental colour would not be so strong that it may easily become ineffective when the explicit cue for the cognitive judgement exists (in this case, emotional words).

To examine in more detail the relationship between the effect of colour lighting and the emotional strength of each conversation, additional analysis was undertaken. Figure 4 shows mean judgement scores for each of the twenty scripts arranged in order of their averaged score over all lighting conditions. Some tendencies can be read in this graph. First, in the scripts with low scores, both the red and blue lightings yield higher scores than the white lighting. Thus, this effect may be one caused by some unusualness of chromatic lighting, not by the nature of specific colour employed. Next, in some scripts with moderate emotional strength (between 45 and 50 on the abscissa), the effect of red lighting is prominent. This should be the effect caused by the specific nature of red colour that is generally thought of as raising people's arousal [4,5]. Finally, in some (not all) scripts with high emotional strength, a score in the blue condition is even lower than a score in the white condition. It may show the effect of blue colour that inhibits our emotional response in the emotional situation. In addition to these effects, we can find a consistent tendency that the effect of colour lighting is likely to disappear when the conversation includes emotional words (E condition; indicated by solid lines), as previously discussed.

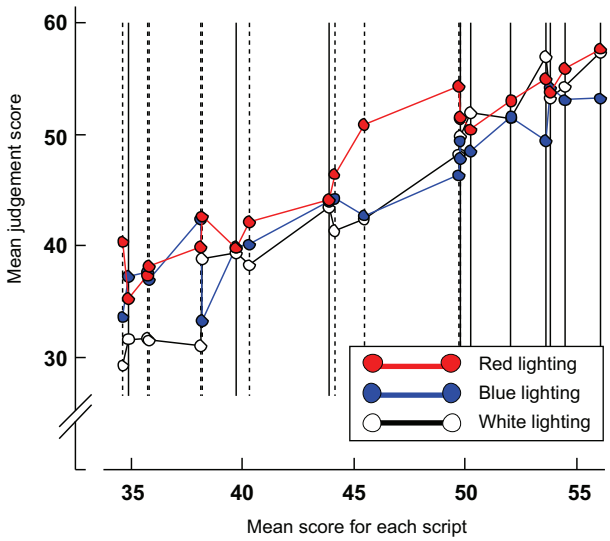

Figure 4 Mean judgement scores for each of 20 scripts arranged in order of their averaged score over all lighting conditions (solid lines indicate scripts in E condition; dashed lines indicate scripts in N condition)

As for the personality estimation of talkers, results did not show any clear difference among lighting conditions. It seems that the environmental colours hardly have an influence on the judgement of the internal impression such as one's personality. It may be also due to the difficulty of the task itself that required subjects to update the impression of talkers while performing another task of emotional–expression judgement.

Conclusion

The present study showed that coloured lighting could have an effect of shifting our criterion of judgement about emotional affairs. Red tends to heighten, and blue tends to inhibit, our emotional response. These results may be suggestive for planning an appropriate lighting environment to various social situations. At the same time, however, limitations of such effects of environmental colours were revealed. It is likely to disappear when other explicit cues for judgement exist (i.e. the situation is not ambiguous), or when we are judging some internal, not external, impression of other people. In order to get more applicable knowledge, further studies employing other kinds of tasks are needed.

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