Lightness modification for a photograph to give natural impression as for the real scene

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1. Introduction

Brightness impression for a scene does not exactly reflect the luminance of the scene as known as the lightness constancy. Under a shelf in a room the luminance is normally very low because of the shade but the brightness impression for the shade does not much differ from the positions above the shelf. The concept of recognized visual space of illumination, RVSI developed by Ikeda et al.[1, 2] explained the lightness constancy as well as the color constancy by the adaptation to the illumination filling a space emphasizing a space recognition. Consequently the constancy does not hold for a photograph viewed under normal viewing condition[3] and dark portion appears dark contrary to the perception, which sometime causes inconvenience by giving erroneous impression of scene. In this paper we will show a modified photograph to give the same brightness impression as for a real room by referring to the data presented in a previous paper[4] and by using the data newly obtained[5]. Such modified photograph should be useful as a photograph in a catalogue to show interior to clients.

2. Experiment

Brightness of a white wall of an experimental room was measured from top to bottom by the elementary color naming method[5], of which data were used in the present paper. The wall had a horizontal shelf to make a shade. The amount of the whiteness W was transferred to the lightness L* by an experiment where the whiteness was measured for a gray scale of which L* was measured by a luminometer. L* was transferred to luminance Y by a formulae to define L*. A photograph of the experimental room was modified in its lightness to meet the luminance Y.

A gray scale composing 16 achromatic chips was observed one by one to obtain the amounts of whiteness and blackness in percentage under the fluorescent lamps of the daylight type at 734 lx. Five subjects participated in the experiment, MI, CP, PL, KC, and SM. A black mask was used to observe only one chip at a time. They observed each chip for five times in different sessions.

A photograph was taken for the front wall of the experimental room and the lightness of the front wall in the picture was modified to meet Y to reflect the whiteness measurement of the front wall under 80 lx.

3. Results and discussion

Whiteness amounts of the grey scale are shown in percentage in Fig. 1. The abscissa gives the lightness L* measured by X-rite spectrophotometer and the ordinate the whiteness percentage. Different symbols represent subjects, ○, MI; △, CP; □, PL; ◇, KC and ×, SM. Each point is the average of five observations. Results vary among subjects. The subject MI shows high percentage for the middle gray scale but PL low percentage for these chips. We took the average of five subjects and obtained a dotted curve. The curve showed a fairly straight shape and a regression line was obtained as shown by a thick solid line. The

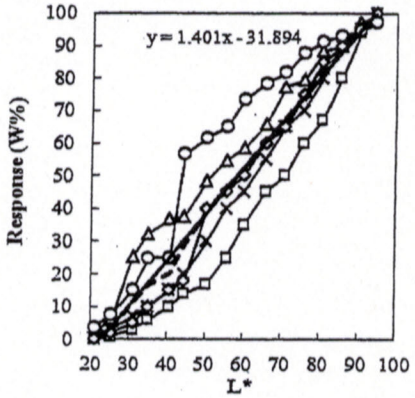

Fig. 1 Lightness and whiteness relation.

CP 2

equation to related W to L* then became,

$$L^* = (W + 31.9)/1.40 \quad (1)$$

To change L* to luminance Y we used the following equation.

$$Y/Y_n = ((L^* + 16)/116)^3, \quad (2)$$

where Y_n is the luminance for a standard white. We know the whiteness amount of the wall from the work of Mookrai et al.[5]. We employed the data obtained under 80 lx of the experimental room and for the shelf depth of 30 cm and calculated Y/Y_n values to be reproduced on the photograph. The luminance of eight points on the front wall of the real room as well as of the photograph was measured by a luminometer Konica Minolta CS-100A. We used the highest luminance at an upper position on the wall as Y_n.

The results of Y values are shown in Fig. 2. The abscissa is the distance on the wall from the floor and the ordinate the luminance Y. Two dotted vertical lines indicate the shelf width seen by a subject. The triangles represent luminance of the real room. There is difference in luminance between walls below and above the shelf. When the whiteness amount was transferred to the luminance for the photograph of the room it became curves shown by circles. Below the shelf the luminance is much higher than the luminance of the real room.

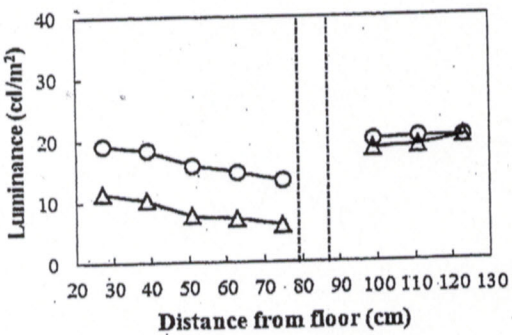

Fig. 2 Physical luminance and apparent luminance.

The final step of this experiment is to modify the photograph of the real room to meet luminance shown by circles in Fig. 2. Photographs of the front wall of the real experimental room were taken by a camera and they were modified by using the level tool of Photoshop CS5.1. After printing out the photographs the luminance was measured at positions given in Fig. 2 to arrive at the luminance given by circles. This was done by trial and error.

The results are shown in Fig. 3. This is a view of the front wall of the experimental room. On the shelf some objects were placed to simulate a normal room. Along the two vertical lines numbers were marked to locate the positions for measurement of luminance and for the elementary color naming.

The left is a photograph before modification of lightness and a dark shade under the shelf can be observed. The right is the photograph that was modified according to the brightness impression. The shade under the shelf is reduced to meet the perception. Interior designers can explain the interior atmosphere more properly to clients by using modified photographs like the picture on the right.

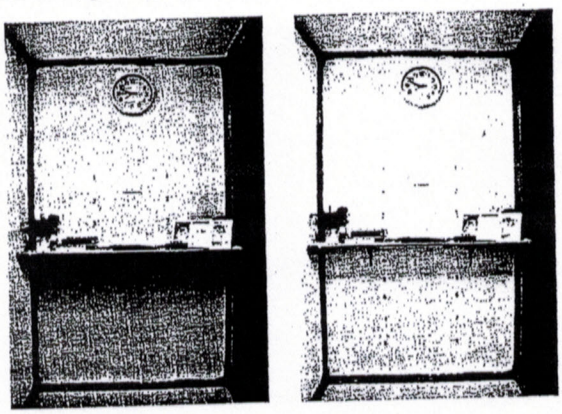

Fig. 3 Photographs without (left) and with modification (right).

References

1) M. Ikeda, H. Shinoda, and Y. Mizokami.: Phenomena of apparent lightness interpreted by the recognized visual space of illumination, Opt. Rev. 5 (1998) 380-386.
2) P. Pungrassamee, M. Ikeda, P. Katemak, and A. Hansuebsai: Color appearance determined by recognition of space, Opt. Rev. 12 (2005) 211-218.
3) C. Phuangsuwan, M. Ikeda, and P. Katemake: Color constancy demonstrated in a photographic picture by means of a D-up viewer, Opt. Rev. 20 (2013) 74-81.
4) C. Phuangsuwan, S. Mooklai, and M. Ikeda: Lightness constancy by using real space environment, Jr. Col. Sci. Assoc. Jpn. 37 (2013) 562-563.
5) S. Mookrai, C. Phuangsuwan, and M. Ikeda: Lightness constancy demonstrated by using real space and various shadows. (Accepted for publication by Jr. Col. Sci. Assoc. Jpn).