Size limit of the color patches for perceiving object color mode by the elderly

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Abstract

The age-related vision change affects elderly safety and quality of life. Cataract is one of the common causes that alter color perception of elderly. The serious problem of the cataract eye is scattering of environment light into the eye. These researches aim to study color vision of elderly relating to the size of the color patches, degree of fogginess and environment light. The simulating technique using goggles with various degree of hazes were employed. The experiment conducted with the 47 elderly was also included. Results of the experiment show that the scattering light causes desaturation of the color appearance to the elderly. The higher the degree of haze the more desaturation occurs. The size limits of the color patch depend on the colors. And to perceived object color mode correctly is 6 degrees of visual angle. The red and yellow are the colors which the elderly can perceive correctly than the other colors, in all experiment sizes. The experiment results from both techniques agree with each other.

Introduction

Most of the daily activities including communication, enjoying visual image, maneuvering in the environment are depend on eye sight. Visual impairment of the ageing related older adults affect their safety and quality of life. Cataract is one of the common causes that alter color vision of elderly. The research at Chulalongkorn University concerned the elderly vision has been established since 2006 by P. Pungrassamee, M. Ikeda and T. Obama. The cataract experiencing goggles has been introduced to study the effect of environmental light on color appearance. This simulating technique using the cataract experiencing goggles, invented by T. Obama and her colleagues, have been used in several researches later on. I divide our work into three parameters, first is degree of haze or fogginess (which can imply to the level of cataract) second is the effect of environmental light which causes flare into the eye and third is the size of the color patches for the elderly to perceive the object color mode. The simulating goggles technique was carried out in the laboratory. I and N. Sungwora-wongphana conducted the experiment with Thai elderly in the outdoor condition. The results from these researches help us to understand the color perception of the elderly. They provide the information for the designers to choose the proper colors and size used in signs and displays for elderly, both indoor and outdoor.

Experiment

The experiment was carried out both in the laboratory and outdoor. In the laboratory, the two rooms technique was employed, a subject room and a test room, with a separating wall between them. The illuminance of two rooms was controlled independently. There was a window on the wall through which the subject could observe the color test patch. The effective sizes of the test color charts were controlled by changing the size of the window (W). The sides of the test charts were 0.7, 1.5, 2.2, 5.9, 10.3, and 24.1 degrees of visual angle for W1-W6 respectively. Four color patches, red, green, blue and yellow were employed. The illuminance of the subject room was set at 10, 70, 150, and 300 lx, and that of the test room at 150 lx fixed. The test patch was shown to the subject randomly one by one in each lighting condition. Subjects judged the color appearance of the test color chart with and without goggles. The elementary color naming method was used. The second experiment was carried out in the open field at Chulalongkorn University. The color test patch, size 20x20 cm², was held vertically at the 155 cm height. It was placed under shade of a tree. The subject stood under the strong sunshine,
illuminance about 50,000 - 90,000 lx, so that the eye received a strong environment light. Fourteen color patches were selected, 10 with high color purity and 4 with low purity. Each test patch was randomly presented to a subject at a time. The subject wore the goggles and walked away until he could not see the color any more. Then the distance between subject and test chart was recorded. The subject repeated the experiment for 5 goggles of different haze value one by one and naked eye. The subjects MI, TK, and PP joined in both experiments. In the last experiment the subjects were 47 Thai elderly living in Chonburi province. It was carried out in the shade outdoor nearby residential area; the illuminance range was 200-5000 lx. Only 8 color boards were presented at 10, 20, 30, 40 and 50 meters distance, which correspond to 1.03, 0.52, 0.34, 0.26, and 0.21 degrees arc of visual angle.

Results

The results of the experiment in the laboratory are shown in Fig. 1(1) for different foggy filters. The ordinate is the amount of chromaticness and the abscissa is the size of color chart. The chromaticness increases rapidly at the small size from 0.7 up to about 6 degrees and stays more or less constant after that. The effect of haze value of the foggy filters is quite clear. Desaturation is stronger as the degree of haze increases for every illuminance. As the environment light increase the effect of haze increase. This result agrees with the previous research of Ikeda and Obama (2).

![Fig. 1](image1.png)

Fig. 1 The average chromaticness of all four colors, five goggles and naked eye of the three subjects (1).

The results of the experiment with the goggles and Thai elderly in the open field are shown in Fig. 2 and Fig. 3, respectively. Although the environment illuminance was different, both results agree with each other. Yellow and red are the easiest colors for the elderly to see in far distance. In Fig. 3, except red and yellow, the percentage of correct answers for other colors starts to drop at the 0.52 (20m.) degrees. That means they could see the colors but the color appearance changes (2). Dark green and blue are the most difficult to be seen in both cases. About 0.2 (50m) degrees they appear as black or cannot be seen.

![Distillation limit in m](image2.png)

**Fig. 2** Distance limit to see colors with and without simulating goggles.

![Ability to see colours of elderly](image3.png)

**Fig. 3** The average percentage of correct answers of the elderly at 10 - 50 meters.

References