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Proper indoor illuminance for elderly people to see signs from outdoors

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ABSTRACT

It becomes hard for cataract eyes to recognize signs and objects placed inside a building from the outdoor where environment light is strong, which reduces the quality of life QOL of elderly people. A solution for this impediment is to increase the inside illuminance level. It was investigated how much illuminance had to be elevated for elderly people compared to the young people by simulating the illumination situation in an experimental room. The cataract eyes were simulated by cataract experiencing goggles. It was shown that the illuminance should be elevated about 6.5 times.

Keywords: Elderly people, Cataract eyes, Cataract experiencing goggles, Quality of life QOL, Building lighting, Recognition of signs

1. INTRODUCTION

People get cataract in their eyes when aged. The most serious impediment from the cataract is the light entering the eyes from environment scatters in the eyes that covers all over the retina causing scene foggy. It also desaturates colors[1], and blurs the retinal image[2]. When elderlies look at a dimly illuminated indoor from a very bright outdoor the indoor appears only a dark space and they cannot recognize objects in the space, while young people have no difficulty to see them because of no scattering light in their eyes. One way to solve this problem is to increase the illuminance in the indoor space. The present paper investigates how much illuminance should be increased for them compared to young people by simulating the cataract with cataract experiencing goggles[3].

2. EXPERIMENT AND PROCEDURE

Two-rooms technique or the environment-stimulus independent illumination technique was employed composing of a subject and test room as shown in Fig. 1. The subject room had length of 4 m and the test room 1.8 m, and their height 2 m and width 3 m. At the separating wall 17 fluorescent lamps FL of 40 watts each and the daylight type were attached facing a subject to simulate the environment light. The vertical plane illuminance at the subject eyes was variable from 0 to a little over1000 lx when the subject sat at the distance 3.3 m from the separating wall. In the experiment five illuminance levels were investigated; 0, 259, 528, 789, and 1054 lx. The inside of a building was simulated by the test room, which was illuminated by 12 fluorescent lamps of 20 watts and the daylight type. Two of them, Ft were adjustable for their intensity by a knob operated by the subject. A test stimulus T was placed against the back wall of the test room and the subject observed it through an opening D of which width was 50 cm, which simulated an entrance of a building. The vertical plane illuminance was measured at the same plane of the test stimulus. Figure 2 is a photograph to show the environment illumination at 1054 lx and a test stimulus in the test room through the opening.

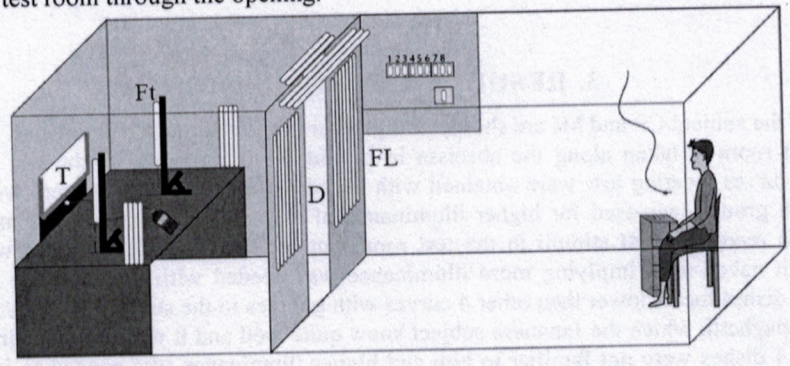

Figure 1. Experimental room.

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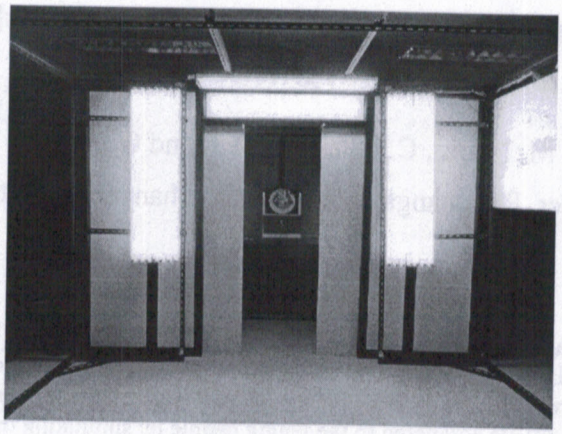

Figure 2. The environment illumination at 1054 lx and a test stimulus in the test room.

The subject task was to adjust the illuminance of the test room by a knob at the level when he/she could understand the contents of the stimulus easily for the decision whether he/she wanted to visit the building when he/she happened to walk on a street and to pass by the building. This was not a threshold for readability of the stimulus and rather a vague criterion but we wanted to simulate real situation of elderly people on streets in town. The adjustment was done with naked eyes and with the cataract experiencing goggles for five times at different experimental sessions.

Ten test stimuli were prepared composing of two types of pattern; 4 posters and 6 dishes. Examples of a poster and a dish are shown in Fig. 3. The poster was to invite people to a seminar held in the building and the dish was one of Thai foods "somtum" that was available in a restaurant in the building. The goggles were developed at Panasonic Co. Ltd.[3] and had the haze value 18% to show the degree of scattering light and the photopic luminous transmittance 63 %. They had less transmittance at short wavelengths. The goggles simulate the cataract eyes, particularly the eyes that just start to cause inconvenience in daily life.

Five subjects participated in the experiment, four young Thai and one Japanese whose eyes were installed with intraocular lenses after operation for the cataract.

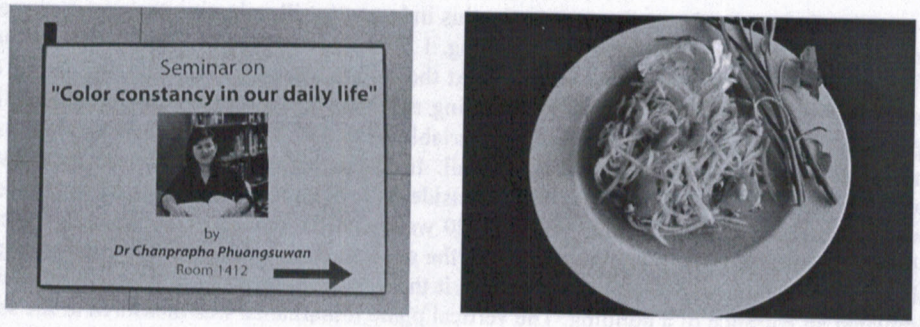

Figure 3. Two types of test stimuli; left, poster; right, dish

3. RESULTS AND DISCUSSION

Results of the subject CP and MI are shown in Fig. 4 for the test stimuli of six dishes. The illuminance of the subject room is taken along the abscissa in lx and the illuminance of the test room along the ordinate. Six curves locating low were obtained with naked eyes and those high were with goggles. The curves of both groups increased for higher illuminance of the subject room showing more illuminance was needed to recognize test stimuli in the test room but the increase with goggles was much larger compared with naked eyes implying more illuminance was needed with goggles. We notice here that curves of two dishes locate lower than other 4 curves with goggles in the subject MI. The two dishes were somtum and spaghetti, which the Japanese subject knew quite well and it was easy for him to identify the dishes. Other 4 dishes were not familiar to him and higher illuminance was needed to identify even the materials used for the dishes. The Thai subject CP did not such peculiarity about the dishes. Three other Thai subjects showed similar results with the subject CP and we decided to average data of the four Thai subjects to get the mean result, which is shown in Fig. 5. Four curves locating in the middle were from

posters with goggles and it was easier to recognize them than dishes. For the curve of stimulus locating at the top the standard deviations among four subjects are shown by short vertical bars. Large SDs indicate large variance of individuals in adjusting the illuminance of the test room. The vague criterion given to subjects for the adjustment caused the variance.

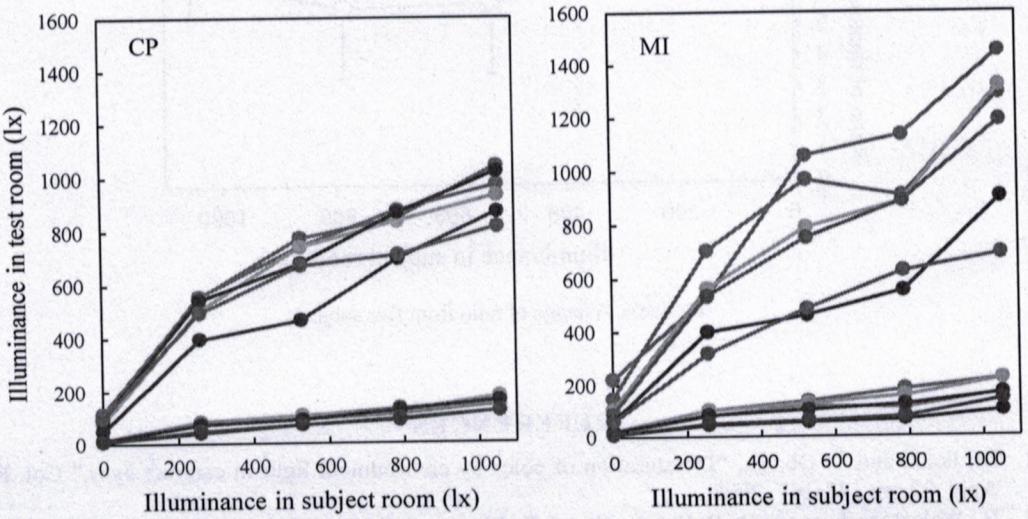

Figure 4. Results of subject CP and MI for 6 dishes of stimuli.

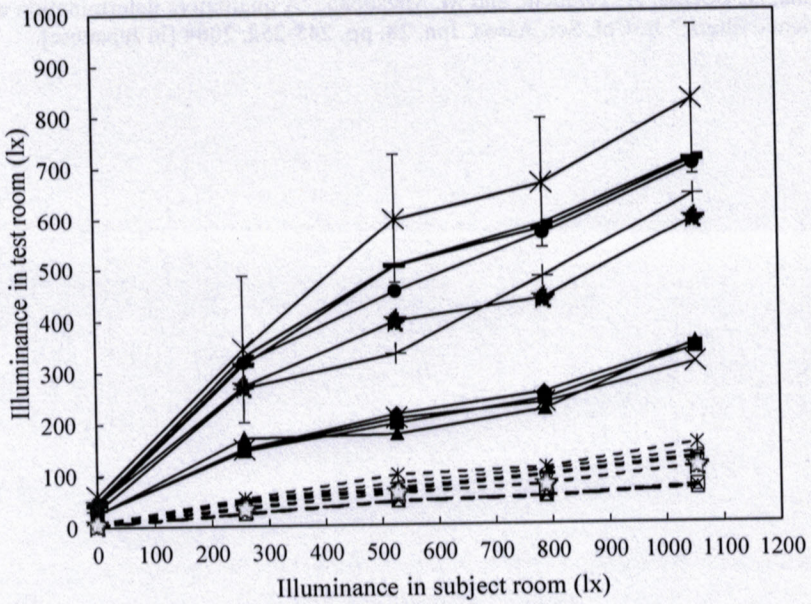

Figure 5. Average data of four Thai subjects.

In order to know how much illuminance should be increased with goggles compared with naked eyes ratio of the illuminance with goggles to the illuminance with naked eyes was calculated for each test stimulus and the average of the ratio was calculated for all the five subjects including the Japanese subject. The result is shown in Fig. 6. Short vertical bars at each data point indicate the standard deviation among five subjects. Although the individual variance is not small the all ratios remain relatively constant for the illuminance level of the subject room by having the average 6.5.

We can conclude that the illuminance in the building should be elevated about 6.5 times from the level designed for young people in order that elderly people also can recognize posters or pictures similarly to young people assuring them the QOL

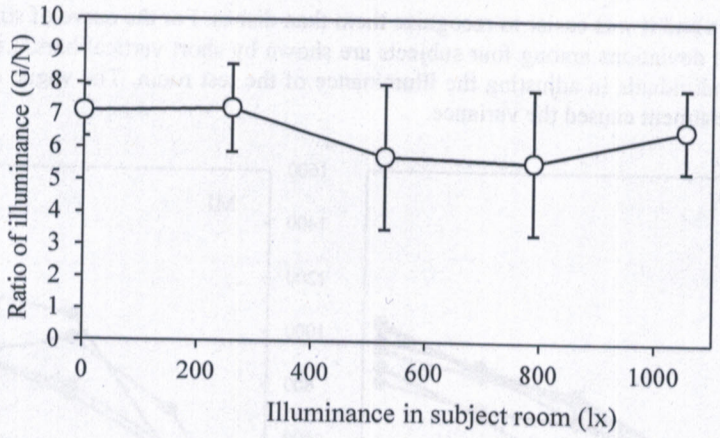

Figure 6. Average of ratio from five subjects.

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