PROPER-SIZED THAI LETTERS ON DIFFERENT BACKGROUND CONTRASTS AND ILLUMINATION ENVIRONMENT SUITABLE FOR ELDERLIES.

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ABSTRACT

Printed labels represent visual environment as they are the targets for getting information of the products. They have been found to be expressed by so small letters and are too difficult for elderlies to read. A serious problem of the visual performance of the elderlies come from the cloudy crystalline lens of the cataract that scatters the incoming light all over the retina. The cataract experiencing goggles composed of color filter, brightness filter, and haze filter that together simulate the elderly vision with cataract. This study experimented on young observers wearing cataract experiencing goggles for the result of elderlies cataract vision on Thai letters legibility. The Thai letters test charts of varying letter sizes for adjustment experiment method made into 3 sets of different backgrounds. The one-room and two-room experimental techniques for different illumination environment study was experimented. Different background contrasts gave different results especially the lower contrast gave worse result for the cataract vision. The two-room technique preserves cataract vision to be as good as normal vision.

INTRODUCTION

The elderly population in Thailand is increasing, and Thailand is emerging the elderly society. When people get older they get cataract and their visual performance deteriorates [1-2]. It is an urgent matter to investigate the performance of elderly vision and to provide proper infrastructure and environment to assure them the quality of life. In this study we pay attention to letter size and background contrast of product labels as the elderly people get information from labels for their daily living. Legibility by elderly people has been investigated by some researchers, Elliott et al. [3] for English, and Ayama et al. [4] for Japanese. They all showed deterioration of the visual acuity by elderly people. But in our knowledge, none investigated for Thai letters and no proposal was made for the Thai letter size recommended for labels to suit elderly people. Thai letters are different from English or Japanese letters. as seen in Figure 1.

The study on legibility was mainly done with high contrast letters, either positive or negative contrast. In the real product labels there are variation of contrast on product labels. It is needed to investigate the minimum letter height of Thai letter visible by elderly people. We employ the cataract experiencing goggles developed by Panasonic in stead of employing real elderly observers. The goggles are composed of density filter, color filter, and haze filter which simulate elderly vision that has cataract in their eyes in the level of the irritating stage that begin to cause some inconvenience in their daily life [5].

The visual performance changes depending on the illuminance level and the contrast of the stimulus. We measured the minimal Thai letter size legible with goggles worn by young subjects under the various illuminance levels and different background contrasts. The same experiment is done for the same young subjects without the goggles to compare visual performance deteriorates when people get older. To observe the effect of environmental illuminance the 2-room concept developed by Ikeda et al. [6-7] were employed. The subject room and the test room are separated by a wall with a viewing window so that the environment light which caused the scattered light into the eyes was reduced.

EXPERIMENT

The letter charts were made with 24 varying letter size which were logarithmically linear distributed for visual angle increment of 0.05 minutes. The 3 charts backgrounds were white, N5 and N4 equivalent in lightness value. Letter charts in each backgrounds are shown in Figure 1.

Figure 1. Test charts in White, N5 and N4 backgrounds.

The adjustment experimental method was used for acquiring the 100% correct response of letter legibility under each illumination levels and background contrasts. Figure 2 shows the adjustment procedure in the one-room experimental room. The cataract experiencing goggles were worn to simulate cataract vision in comparison to the normal eyes of the other session. Five subjects aged 25-35 years old experimented for normal eyes and eyes with goggles. The 1-room and 2-room experiment were conducted for comparison of illumination environment affect on legibility. Experimental conditions for 1-room and 2-room were concluded in Table 1.

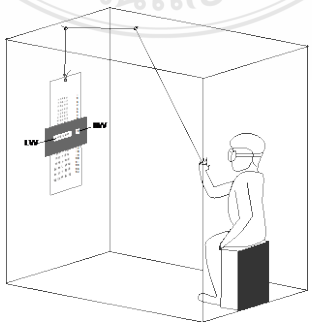

Figure 2. Subject performs adjustment method in 1-room with goggles wearing on.

Table 1. Experimental conditions

Experiment	1-room Conditions	2-room Conditions
Subject room illuminance (lx)	20, 80, 280, 800, 1500	0, 5, 20, 80, 280, 800, 1500
Test room illuminance (lx)	-	280
Font type	TF Srivichai	TF Srivichai
Background contrast	White, N5, N4	White, N5, N4
Goggles	Off, On	Off, On
Viewing distance (cm)	120	150
Repeating (sessions)	10	5

RESULT

The results from 1-room experiment showed that legibility of eyes with goggles lowered when illumination decreased from 800 lx to 20 lx, compared to normal eyes. The result of darker background or lower contrast label showed that eyes with goggles were greatly affected with the lowered illumination, while the normal eyes were not much affected, as demonstrated in Figure 3.

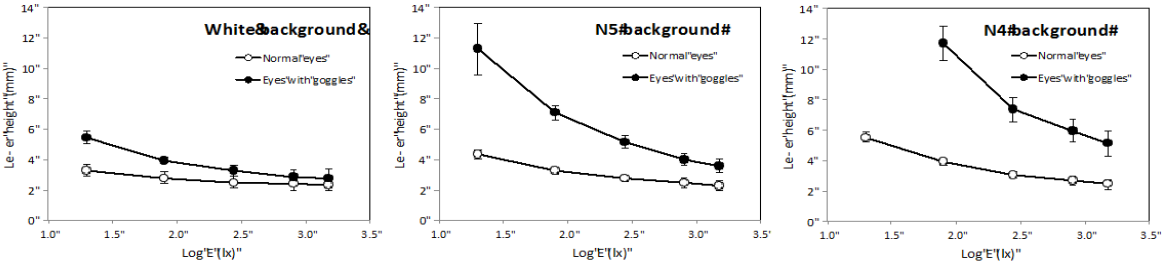

Figure 3. Letter height comparison on 3 backgrounds for 1-room.

The results from 2-room experiment showed that legibility of eyes with goggles preserved when illumination of subject room was not higher than illumination of the test room (dotted vertical line). The result from lower contrast backgrounds showed greatly deteriorated legibility on eyes with goggles while not much affect on normal eyes, as shown in Figure 4.

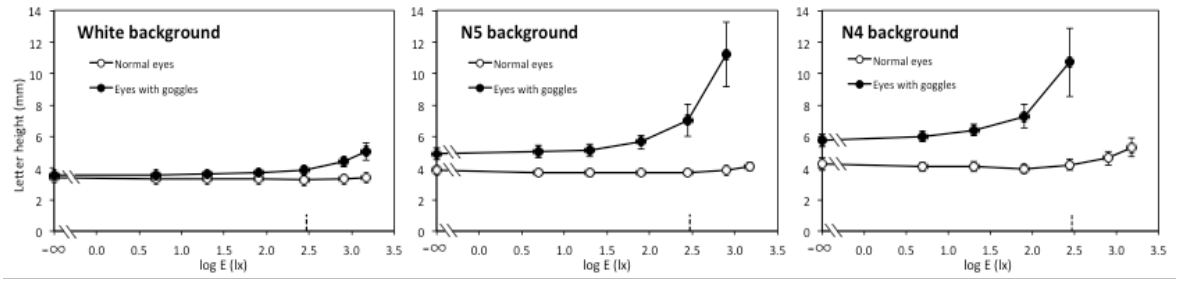

Figure 4. Letter height comparison on 3 backgrounds for 2-room.

The integrated analysis of 1-room and 2-room comparing visual angle of 100% correct reading showed that eyes with goggles suffered a lot when background contrast is lowered compared to normal eyes, as shown in Figure 5 of N4 backgrounds. However, the reduction of subject room illumination can improve legibility greatly for the eyes with goggles.

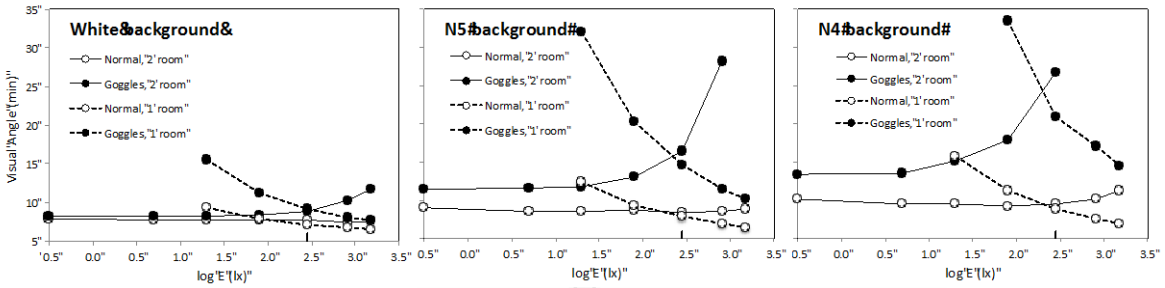

Figure 5. Compare result of 1-room and 2-room

CONCLUSION

Legibility of cataract eyes lowered substantially when illumination decreased from 800 lx to 20 lx, compared to normal eyes. The deterioration increased when background contrast decreased. The lower contrast labels greatly affect legibility of cataract eyes or elderly vision, compared to higher contrast labels. The letter sizes, background contrast, and illumination factors should be together concerned to prepare labels suitable for elderly. The 2-room illumination system where light in the subject room was kept low and light at stimulus area was normal, is suitable for elderly. The environment light should be controlled to avoid the direct scattering to elderly eyes.

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REFERENCES

1. Owsley, C., Sekuler, R., and Siemen, D. (1983). Contrast sensitivity throughout adulthood. *Vision Research, 23,* 689-699.
2. Arditi, A. (2005). Enhancing the visual environment for older and visually impaired persons. *Alzheimer's Care Quarterly, 64*, 294-299
3. Elloit, D. B., and Situ, P. (1998). Visual acuity versus letter contrast sensitivity in early cataract. *Vision Research, 38,* 2047-2052.
4. Ayama, M., Ujike, H., Iwai, W., Funakawa, M., and Okajima, K. (2007). Effects of contrast and character size upon legibility of Japanese text stimuli presented on visual display terminal. *Optical Review 14,* 48-56.
5. Obama, T., Uozato, H., Terauchi, H., and Matsuoka, H. (2004). A qualitative determination of senile cataract experiencing filters. *Journal of Color Science Association of Japan, 28,* 245-252. [in Japanese]
6. Ikeda, M., and Obama, T. (2008). Desaturation of color by environment light in cataract eyes. *Color Research and Application, 33,* 142-147.
7. Ikeda, M., Pungrassamee, P., and Obama, T. (2009). Size effect of color patches for their color appearance with foggy goggles simulating cloudy crystalline lens of elderly people. *Color Research and Application, 34,* 351-358.