

Visual Perception of the Aged in the Night: Effect between Attributes of the Color

I. Okamoto and M. Kobayashi†*

** Osaka Kyoiku University, Faculty of Education, 4-691-1 Asahigaoka, Kashiwara, Osaka(Japan)*

† Osaka-Shoin University, Faculty of Arts and Sciences, 4-2-26 Hishiya Nishi, Higashi-Osaka, Osaka (Japan)

Corresponding author: I. Okamoto (okamoto@cc.osaka-kyoiku.ac.jp)

ABSTRACT

This research aims at the supplement with the information of visual perception and the arrangement of color environment in night in order to support the daily life of the aged who live independent and healthy.

We made the light source equipment for this research, and examined the effect between attributes of the color. The experiment was so conditioned, that a stimulus on one side was fixed and another stimulus was moved. The stimuli used for the experiment consist of several kinds of columns, and they differ from another one in color and size.

A person as a subject makes response, when both stimuli were recognized as the same position. The subjects tend to make response in the more distant position than a datum point in the forward direction and in the reverse direction too.

The column of diameter 20mm, i.e., a small stimulus, gave the large distance to the subjects between two stimuli at the time of recognition. When a light source is horizon sunlight, in comparison with white- and daylight, the difference of the distance between two stimuli is small at the time of recognition.

We think that the visual perception of the elderly people is little influenced by the color of a light source. We suggested that the constant mechanism was acting on the change of visual perception which appears by aging.

1. INTRODUCTION

There are 24,810,000 Japanese elderly people (65 or more years old) in September, 2004. The rate of aging is 19.4%. More than 90% of the aged feel fine physically, and living healthy their daily life.

Researches on the functional characteristics of the vision of the aged have been done in various domains besides medicine, engineering, psychology and etc. And as for elderly people, the research on a visual function occupies high ratio in the data base of a body function.

There has been a research with the solid picture which was shown on the CRT display¹. However, there is little research about visual perception of the elderly people by the experiment, in which the color solid itself moves.

In the equipment of this experiment we can measure an exact position with the solid stimulus which moves in some optical environment, such as photopic and mesopic. The subjects of this research are healthy elderly people, and we are examining visual perception by the experiment, in which we used the solid stimulus.

2. METHOD

We made the inspection equipment for examining visual perception (Figure 1). In this equipment we can change the kind of light source and control illuminance too. Visual field of this equipment is 10 degrees. This equipment has three slide guides and each of them is connected with the handle. The target stimulus is moved by rotating the corresponding handle.

For the experiment we used a pair of the parallel solid stimuli, fixed the stimulus on one side, and moved another one. Therefore the stimulus of the standard is fixed. Another stimulus was moved forward or in reverse under various conditions in the equipment. A subject makes response when the

subject recognizes it as the same position. We measured the distance between the stimuli and judged visibility (Figure 2).

A set value is ± 0 , if the moving stimulus stops at the same position as the fixed stimulus. The plus sign is set in the case when the moving stimulus stops near by the subject. On the contrary, the value becomes minus when the stimulus stops at the handle side (Figure 3).

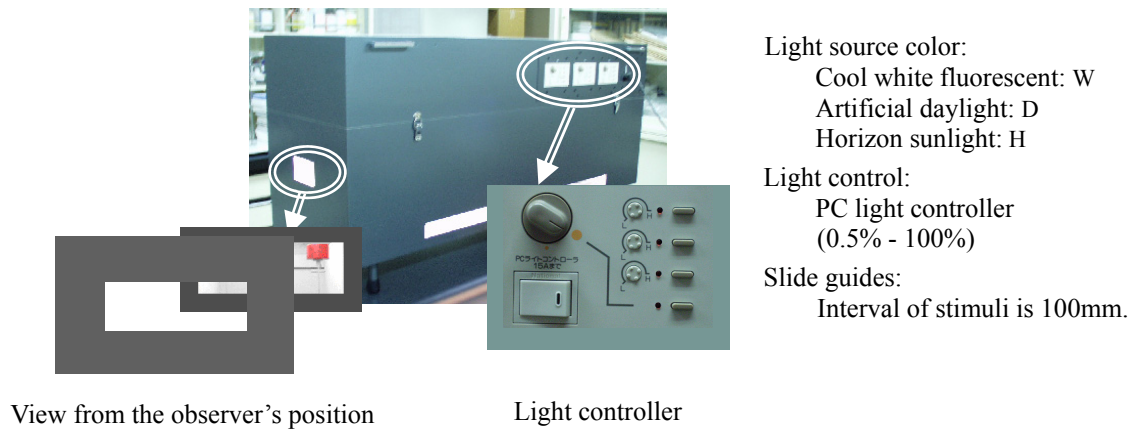


Figure 1: It is possible to move each stimulus in this equipment, and the change of the kind of light source and control of illuminance are also possible.

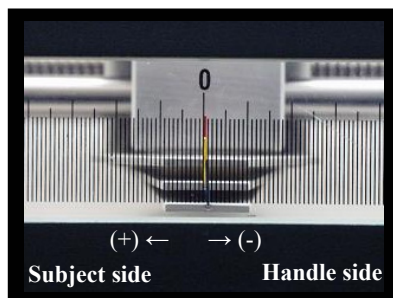


Figure 2: Scale for measuring the position of the stimulus which is stopped with the subject's response.

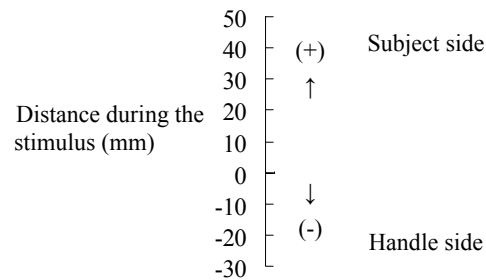


Figure 3: Signs attached to the scale which measured the position of the moving stimulus. It is used for the graph.

As stimulus is used column (height is 30mm). The diameters of the column are 20mm, 30mm, 40mm, 50mm and 60mm. Four colors, such as red, blue, yellow and gray (Table 1) are used as the colors of the stimulus. And, chromatic color is based on the safety color of Japanese Industrial Standard (JIS) ². The stimulus is measured by spectrophotometer (used SZ-Σ90: NIPPON DENSHOK INDUSTRIES Co., Ltd.).

Table 1: Chromaticity of the stimulus on experiment of visibility.

color	L^*	a^*	b^*	HV/C	JIS Reference data (HV/C)
red	40.7	58.4	49.9	8.4R 3.9/15	7.5R 4/15
blue	33.6	4.0	-38.7	4.2PB 3.3/9	2.5PB 3.5/10
yellow	75.9	11.4	86.5	1.1Y 7.4/13	2.5Y 8/14
gray	67.1	-1.3	2.7	N6.5	-

The light source color of the equipment for the experiment about visibility was measured with the color illuminometer (used CL-200: KONICA MINOLTA Co., Ltd.). The details of the light source for the experiment are shown (Table 2).

Table 2: Characteristics of light source for measuring visibility. (Upper part: *gloom*. Lower part: *bright*. Correlated color temperature: T_{cp} (K). Sensory color temperature: MK^{-1} .)

<i>light source color</i>	<i>x</i>	<i>y</i>	<i>Ev(lx)</i>	<i>T_{cp}</i> (K)	<i>MK⁻¹</i>
cool white fluorescent	.3672	.3685	54	4,326	231
	.3722	.3657	1,940	4,155	241
artificial daylight	.3199	.3385	36	6,094	164
	.3209	.3364	2,044	6,050	165
horizon sunlight	.4590	.4106	48	2,717	368
	.4660	.4169	1,692	2,674	374

$$MK^{-1} = 1,000,000 / T_{cp} \text{ (K)}$$

The observing behavior of the moving stimulus requires of the subject concentration. The subjects are 79 years old who are healthy man and woman. But we judged through the preliminary experiment they are as subject enough equipped with the qualities.

3. RESULTS

We determined the position of a fixed stimulus 60cm distant from a subject in consideration of the fatigue of the subject. As for the illuminance the conditions were set for about 1,900 lx and about 50 lx , because it is recommended the brightness of 1,900 lx under the working environment. The brightness of 50 lx coincides, on the other hand, with the gloomy environment such as the corridor and the stairs. The remarkable difference was recognized among the light sources about sensory color temperature ($>40\text{--}50\text{ MK}^{-1}$)³. But the color of the Illuminance wasn't influenced by the control of the light (in such case as "bright" vs. "gloom").

It shows visibility of the solid stimuli in a source of cool white fluorescent (Figure 4, 5). The subjects tend to make response in the more distant position than a datum point in the forward direction and in the reverse direction too. Especially the subjects tend to respond in the far distance from the datum point with the stimulus, which is bright (Yellow and Grey) and small (Diameter: 20mm.)

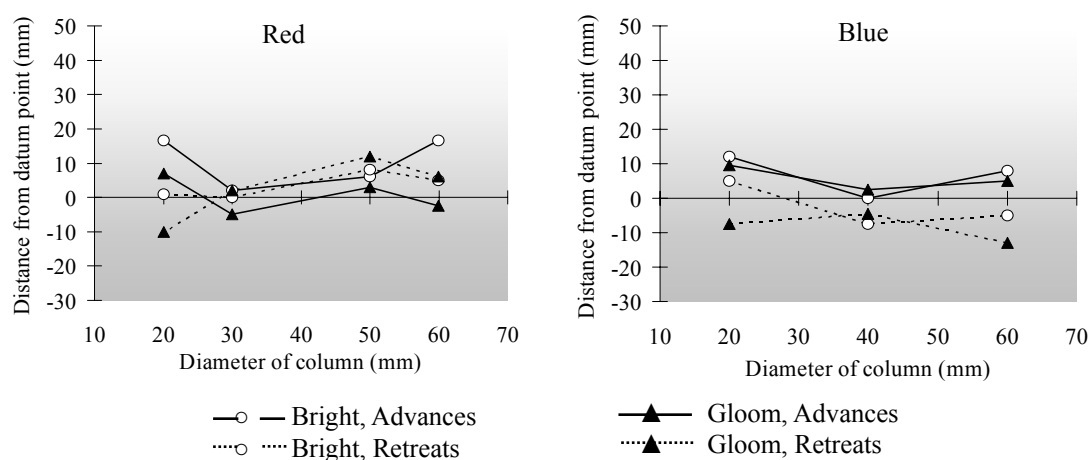


Figure 4: Visibility of the solid stimulus in a light source of cool white fluorescent. Stimuli: Red and Blue. Case report: Male.

The grey stimulus showed under various stimuli the most stable visibility with the changing conditions. The red and blue stimuli were not influenced by their volume on visibility. Moreover the stimulus of the diameter 40mm, which has nothing to do with the color, showed the stable visibility.

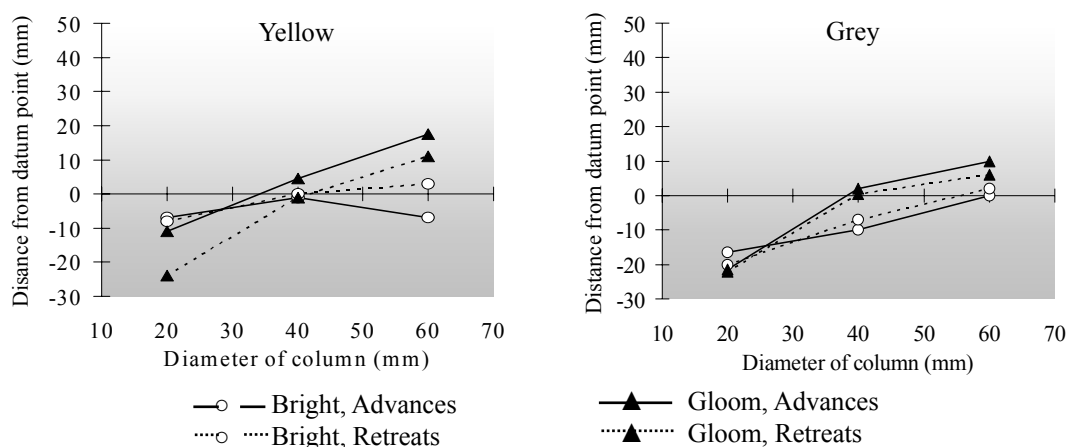


Figure 5: Visibility of the solid stimulus in a light source of cool white fluorescent. Stimuli: Yellow and Grey. Case report: Male

4. CONCLUSIONS

This research aimed at the supplement with the information of visual perception and the arrangement of color environment in night. We made the light source equipment for this research. The subjects of this research were healthy elderly people.

We conclude just from the above mentioned things that the human sight takes balance between the change of the vision with the aging and the adaptation to the change. It is possible to think that a kind of the mechanism of the visual perception acts on the subject, so that the color appearance may not be changed by the influence of the aging⁴. We suggested that the suitable color and the suitable volume were important in order to have stable visibility.

This research is a kind of case report. We go on with the research of the change by aging in cooperation with the same subjects. We plan, furthermore, to use various forms of solid as the stimulus. We collect now three-dimensional data for this purpose by using the non-contact 3D digitizer.

This research was done by the support of Japanese grant-in-aid for science research (project number 12680105.)

REFERENCES

1. M. Omori, H. Nakano and M. Miyano, "Aging effects of advancing and receding in stereoscopic view", *Journal of the Color Science Association of JAPAN*, 28, Supplement, 96-97 (2004).
2. Japanese Industrial Standards Committee, "JIS Z 9101: Safety colours and safety signs", Japanese Standards Association (1995).
3. T. Nakajima, R. Chikada, K. Mende, "Primer of the lighting design", Shokokusya, Co., Ltd. 38-39(1995).
4. The special research committee about the effect on the aging of the visual characteristic, "The fundamental examination about the lighting environment: in consideration of the visual characteristic about the aged", *The Illuminating Engineering Institute of Japan*, 26-34(1999).