Similarity of colors and conspicuity of color combination for younger and older people

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1. Introduction

While there is strong need for designing conspicuous color combinations in visual signs and signals, no systematic way has been proposed for creating such color combinations. This is exactly true for older people whose color vision changes with age.

In this study, similarity of two different colors were quantitatively measured for both older and younger people, and on the bases of color similarity a systematic way for creating conspicuous color combinations was considered. This type of design method is addressed as "Accessible Design" which aims to provide products and environments useful for older people and people with disabilities.

2. Method

Figure 1 shows a procedure to measure color similarity. The subject was given a color chip selected from a total of 200 color chips varied in Hue, Value, and Chroma in the Munsell color space, and was asked to select color(s) that looked "similar" in color appearance to the test from a total of 16 reference color chips placed in front. There is no restriction for the number of selected colors. This procedure was repeated for all the 200 test chips.

The data collected in this way were analyzed so that how much percent of the total subjects judged each test vs reference combination similar. These similarity data were compiled for each of the 16 reference colors to see the span of color similarity for the reference color.



Figure 1. A schematic drawing of the experiment for measuring color similarity between the test and the reference color chips.

This experiment was carried out in six different countries (China, Germany, Korea, Japan, Thailand, and US) to see the national difference using same color chips and same luminance condition. About 20 older and 20 younger subjects were participated in each country.

3. Results

An example of the data for a red reference color (5R5/12) is shown in Figure 2(a),(b). Figure 2(a) contains data for 6 different countries, and Figure 2(b) is the average over the 6 countries. The similarity data is continuously decreasing as the test color is apart from the reference color, and a contour can be drawn by setting some similarity level that forms a span (or a

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group) of colors of similarity. In the figure, four levels of similarity from 70% (extremely similar), 50% (highly similar), 30% (moderately similar), and 10% (slightly similar) are shown.

(a) Data for 6 countries



(b) Average of 6 countries' data



Figure 2. A span of similar colors against a reference color of red (5R5/12) expressed in the Munsell color space (Value 5 plane only). Data are for older persons. (a) Data for six different countries (CN: China, DE: Germany, JP: Japan, KR: Korea, TH: Thailand, and US:US of America). (b) Averaged data over the 6 countries. Contours are drawn for each of the similarity levels of 70, 50, 30, and 10 %.

Although some differences are found among the data in six countries, the span of similarity for the red color are quite consistent and the averaged data can be drawn over the countries, which is shown in Figure 2(b).

The data shown in Figure 2(a),(b) are for older people and the similar data for younger people were also obtained. The span of similarity of older people, for any level and for any reference color, was always smaller than that of younger people. 4. Application; Color combination

Referring data for spans of color similarity, it is create color possible to conspicuous combinations in a simple and systematic way. Figure 3 shows an example. If one selects some different color groups not overlapping each other and picks up one color from each group, any color combination of those selected colors will become conspicuous because those colors are belonging to different groups (see Figure 3). The choice of a color from a group is arbitrary as long as it belongs to the group which is a practical advantage for the visual sign designers.

As there is difference in the span of color similarity between older and younger people, one should use the data for older people when he/she takes care for better visibility to older people.



Figure 3. An example of color combination using color spans of similarity.

The care for older people and people with disabilities is becoming an important issue in every design field, which is called "Accessible Design" and some standard methods are being developed in ISO etc. This method of color combination offers a useful tool for making the visual sign accessible to older people.

References

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