

# Span of colors similarities of the low vision

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## Introduction

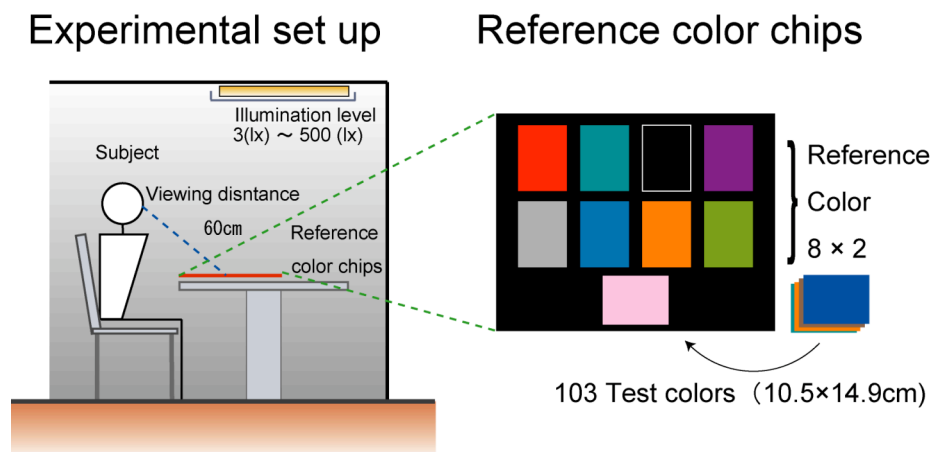
Color is one of the important information to characterize visual appearance of objects and environments. However, considering the low vision, whose symptoms are extremely varied, it is difficult to figure out what is the most appropriate color combination distinctly perceptible to the low vision.

Berlin and Kay (1967)<sup>1</sup> have proposed that the order of evolution of colour words is highly conserved across languages. On the other hand, Uchikawa (2000)<sup>4</sup> studied that the categorical difference effects the search time of target (color) among the heterochromatic stimuli. From these previous studies, it seems that some span of colors may exist which becomes the key to select easily distinguishable color combinations.

Therefore, in this study, span of colors for the low vision based on the similarity to basic colors were measured. In addition, comparing with the data of young subjects<sup>5</sup> who have normal vision, the fundamental knowledge of color usage recognizable to the low vision are discussed.

## Method

Fig. 1 illustrates the experimental set up and the reference color chips. Total 18 reference colors including the basic colors of categorical color theory are selected from the three dimensional Munsell color space (MCS). Each one of the reference colors is compared similarity with the total of 103 test color samples. The experiments were carried out under two illumination conditions, 500 lx, and 3 lx. The subject judged 'same', 'similar', or 'different'. Seven low vision patients were participated in the experiment.



*Figure1. Experimental conditions*

## Results and Discussion

Fig.2 shows the span of color expressed in value 5 and 7 plane of MCS for four fundamental colors, 5R5/12(red), 5G5/8(green), 5B5/8(Bleu) and 5Y7/12(yellow). The solid line shows the span of color judged by the 7 low vision subjects and dotted line shows the span judged by normal vision young subjects. Star shaped color marks show the reference colors. And solid color circles show the test colors which were judged either same or similar to the reference colors. Also the larger circles show the position of the colors which were judged as the same category of colors, red, green, blue, and yellow.

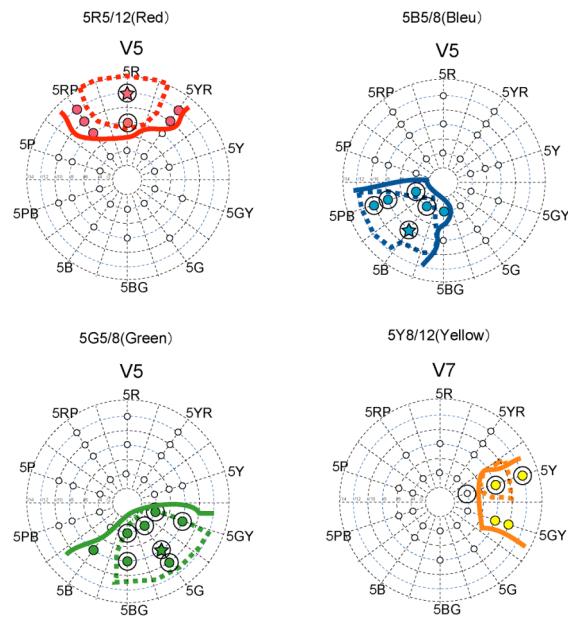


Figure2. Span of similarities

Comparing with the data of the normal young subjects, the span of fundamental colors are broader for the low vision patients in both photopic and mesopic conditions. It is also found that the areas of the span spread widely on the same value plane but do not spread so much on the different value plane. On the other hand, span of the categorical color naming is not so broad as the span of color similarities. Although number of the subjects is not enough to conclude, it is inferred from this experiment that the judgment of similarity by some low vision patients are more dependent on the value plane of colors than the chroma or verbal coding. Therefore the difference of value plane (of colors) is the guideline to select the distinctly different color combination perceptible for the low vision.

## Reference

1. Berlin B. and Kat P. (1969): *Basic color terms: Their universality and evolution*, Berkeley: University of California press.
2. Yokoi K, Uchikawa K. (2005). Color category influences heterogeneous visual search for color. *Journal of the Optical Society of America. A, Optics, image science, and vision*, 22(11), 2309-2317.
3. Sagawa K. and Takahashi Y. (2003): Span of categorical colors measured by similarity of colors, *Proceedings of the 25<sup>th</sup> session of the CIE*, International Commission of Illumination, D1-64-D1-67.