

# Color as a node of crossmodal perceptions for our better life

Miho Saito

Faculty of Human Sciences, Waseda University

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## 1. Introduction

Crossmodal perception or multi-sensory perception (or integration) has recently become a subject of current interest, especially to researchers in the fields of psychology and neuroscience. This presentation describes one of the approaches adopted in crossmodal studies, using the concept of color as a node for sensory perception.

## 2. Classification of fragrances by color

The first study attempted to classify smells (excluding bad smells) by employing similar psychological images with those elicited by colors. The study which commenced in 2002 in collaboration with *Kanebo Cosmetics Co. Ltd.*, Saito, Okui, Yamada, Sawada & Komaki<sup>1</sup>, and Saito<sup>2</sup> examined mutual psychological and physiological interactions in color-fragrance combinations with subjects experiencing smells in colored spaces. The subjects' impressions and feelings were evaluated using the semantic differential (SD) method and Mood scales by POMS. We also used contingent negative variation (CNV), electrocardiograms, and salivary chromogranin A (CgA), an incremental index for emotional stress, to determine psychological indices. We found that, psychologically, a matching pair consisting of a peach smell and pale pink particularly enhanced the impressions and feelings characteristically created by the smell. On the other hand, when the peach smell was paired with a disharmonious color, such as olive or dark blue, the smell aroused unpleasant feelings. Physiologically, the CNV values showed that while pale pink tended to calm subjects when paired with the peach smell, it was inclined to invigorate subjects when

disharmoniously combined with a cedar wood or spearmint smell. The electrocardiograms showed an increase in the HF value for two matching pairs: pale pink and peach smell, and vivid blue and spearmint smell. On the other hand, the cardiograms showed a decline in the same value for two disharmonious pairs: the pale pink and spearmint smell, and the vivid blue and peach smell. Moreover, the CgA density measurements revealed that vivid blue tended to create stronger emotional stress and a higher CgA density when it was combined disharmoniously with the peach smell than when it was paired with the spearmint smell. These results suggested that colors and fragrances might be classified by the concept of harmonious combinations, with similar psychological impressions.

According to the outcomes of the studies above, Miura & Saito<sup>3,4</sup> researched color-fragrance combinations using more fragrances, including spices, to develop a formula describing the harmony between fragrances and colors. Using multiple regression analysis, we obtained regression formulas for predicting which colors are harmonious or disharmonious for a given fragrance.

The data obtained from the two experiments we conducted were analyzed by factor analysis, which indicated that colors that were positively correlated with the 'mild' or 'clear' factor of fragrance impressions and the fragrances that scored high on 'mild' or 'clear' were harmonious with pale pink (vanilla) and pale sky (peppermint). Anise-olive and pepper-dark green were harmonious combinations that were negatively correlated with both the 'mild' and 'clear' factors and scored low on both of them. On the other hand, colors that were positively correlated with the 'mild' or 'clear' factor and fragrances that scored low on 'mild' were disharmonious,

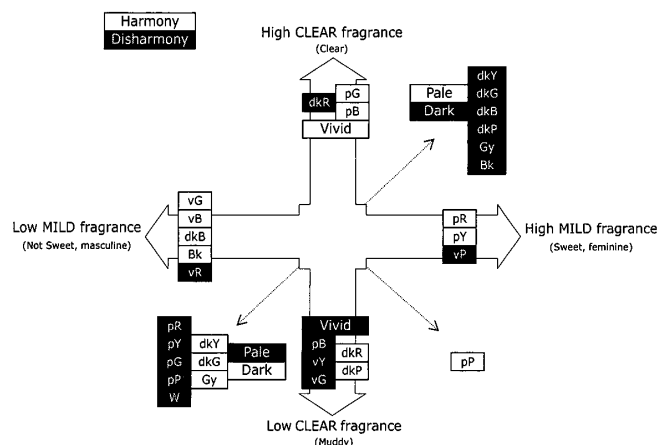


FIGURE 1 | Harmonious color model with fragrance on their dimensions in impressions. This figure shows harmony relationship between color and fragrance on the dimensions in impressions of fragrance (MILD and CLEAR factors). Positions of each color show which color correlated with either or both of the factors.

such as vanilla-dark blue, and peppermint-dark red. Therefore, we can predict, to some extent, the harmony between a fragrance and a color on the basis of the dimensions of fragrance impressions. Figure 1 shows the classification of fragrances by the axes of 'mild' and 'clear' with their harmonious colors.

### 3. Classification of music range by color

The next study was to classify music range by color, based on the similarity of psychological impressions produced by both. Takami, Wakata & Saito<sup>5</sup> asked 60 university students to select harmonious combinations of colors and music ranges. The two musical compositions selected were J. S. Bach's 'Suiten für Violoncello solo', and Mussorgsky's 'Tableaux d'une Exposition' in different ranges (C, B, B $\flat$ , A, G, F, E, D), and the color stimuli were chosen from the PCCS (Practical Color Coordinate System) in the group of 11 tones, (v, b, dp, lt, sf, d, dk, p, ltg, g, dkg) and a group of grays in gradation were evaluated by the SD method. Then the subjects were asked to select the harmonious or disharmonious combinations for each music range with tones.

Factor analysis (Figure 2) showed that the music registers were well related with the 'potency' factor, which consisted of feminine-masculine, light-heavy, bright-dark and sharp-dull. In other words, high ranges harmonized well with bright, light and clear colors, while low ranges were compatible with dark and heavy colors.

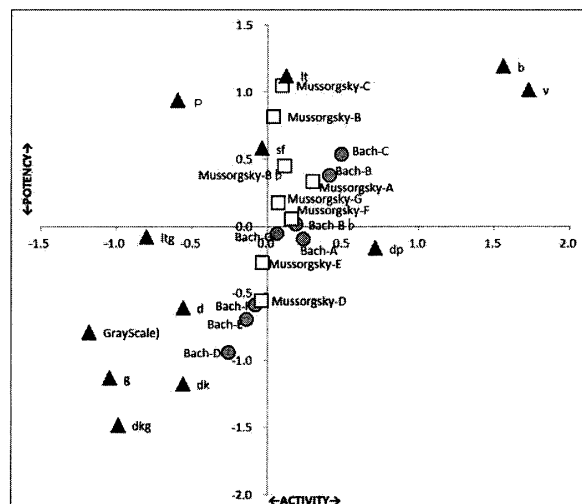


FIGURE 2 Plot of harmonious combinations with colors and music ranges by factor analysis.

## 4. Discussion

Although the studies introduced above only mark the beginning of studies of crossmodal perception, the results suggest possibilities for practical application. Such as making it possible for people to predict and select harmonious combinations of colors and fragrances, or color and music for use in everyday life or in fields such as marketing, medicine, and others. The results of our studies suggested that certain color-fragrance or color-music combinations may affect each other in such a way as to enhance harmony. We also reported the psychological and physiological relaxing effects of some color-fragrance combinations, which may facilitate the creation of a comfortable space, made possible by being surrounded by one's preferred color, fragrance, music and so on. We hope that the results of our study can be applied to contribute to human health and happiness for a better life.

## References

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