

## Non-random association between vowel sounds and colors

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It has been suggested that graphemes of similar sound tend to be associated with analogous synesthetic colors in grapheme-color synesthesia (Asano & Yokosawa, 2011; 2012; Shin & Kim, 2014). A work in our group also showed that graphemes sharing phonetic rules – i.e., the place and the manner of articulation – tend to induce similar synesthetic colors (Kang et al., ASSC 2014). In the present study, we investigated whether phonetic properties are associated with colors in a specific manner even when other visual and linguistic features of graphemes are removed. We employed Haskins Laboratories articulatory synthesizer to generate vowel sounds as our stimuli by systematically manipulating gender (male and female voice) and tongue body position ('frontness' and 'height') (Iskarous et al. 2010, Nam et al. 2004). Four Korean grapheme-color synesthetes and nine non-synesthetes underwent a modified version of the standardized color-matching procedure (Eagleman et al., 2007) where they matched colors three times for each auditorily presented vowel sound. The matched RGB values were converted to HSV values and to CIE Lab color coordinates. Results showed the difference in both saturation and value of matched colors between male and female voices in most participants. However, only the synesthetes showed a consistent trend; male voices were associated with less saturated and darker colors than were female voices. In addition, saturation and value of the matched colors were higher for the vowel sounds generated at front. For the four participants (two synesthetes and two non-synesthetes) who showed statistically significant color-matching consistency, the front and high vowel stimuli were associated with brighter colors (L), and the high vowel stimuli were matched with more greenish colors (a\*) on a red-green color axis. These results imply that the association between phonetic features and colors is not random, and this synesthetic association might be extended to individuals without synesthesia.

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