Conscious awareness of inducing stimulus is necessary for synesthetic color perception

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Background: People with color-graphemic synesthesia experience vivid colors when viewing achromatic alphanumeric characters. The question of whether an inducing character should be consciously perceived for synesthetes to experience synesthetic color has been examined extensively, but experimental results to date have been providing a mixed picture (Mattingley et al., 2001; Ramachandran & Hubbard, 2001; Rich & Mattingley 2005; Smilek et al., 2005; Wagar et al., 2002). We performed a couple of experiments to investigate the role of conscious visual awareness in synesthetic color experiences. Experiment 1: We manipulated the visibility of a character by exploiting a psychophysical technique called continuous flash suppression (CFS, Tsuchiya & Koch, 2005). A full contrast dynamic CFS display was used to suppress a target character (actually colored non-inducing character or achromatic inducing letter) presented to the other eye for a few seconds. Observers performed two kinds of 2-AFC tasks; on some trials, observers were asked which color they saw and on other trials, they were asked which character they saw. Synesthetes' performance on both color & character was near perfect when the color was real but was at chance when the color was synesthetic. This result suggests that the letter was not able to induce synesthetic color when that letter was presented outside of awareness. Experiment 2: We further examined whether conscious recognition of an inducing character should precede synesthetic color perception by utilizing pairs of alphanumeric characters of which forms look ambiguous when rotated (e.g., W/M or 6/9). On each trial, an achromatic target character in one of 12 different angles (30, 60, 90, 120, 150 degrees clockwise or counter-clockwise, in addition to 0, and 180 degrees) was presented briefly (100msec), which was followed by a pattern mask. Observers performed two kinds of 2-AFC tasks; on some trials, observers were asked which color they saw and on other trials, they were asked which character they saw. Synesthetes' RT performance showed that it took longer time for them to judge color than to judge character, as the ambiguity of the character increased. This result suggests that additional processing time is required for synesthetic color experience after an inducing character is recognized. Conclusion: Results from Experiment 1 & 2 indicate the necessity of conscious awareness of inducing stimulus for synesthetic color experiences.