On the automaticity of synesthesia

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Introduction

Contemporary accounts of grapheme-color synesthesia suggest that the experience of color is an automatic result of grapheme presentation. To assess the degree of automaticity, we compared synesthetic automaticity to a better understood form of automaticity: word reading.

Word reading automaticity is gauged by the Stroop effect, whereby literate individuals are slow to name the display color of words that elicit incongruent responses (e.g., say "red" to the stimulus BLUE). Synesthetic automaticity is gauged by a variation on the Stroop task, in which synesthetes are slow to name the display color of graphemes that elicit incongruent color experiences (e.g., if "A" elicits blue, then it is difficult to say "red" to the stimulus A).

Many synesthetes report that the synesthetic color of words is determined by the color of the first letter, although color words are usually an exception (i.e., the synesthetic color of color words is usually affected by the meaning of the word). We have tested one synesthete (CS), however, for whom some color words are synesthetically colored by their first letter rather than their meaning:

1st Letter: red, orange, yellow, brown, black, white, gray

Meaning: green, blue, purple, pink

These two types of color words raised interesting questions about how CS would perform on a standard Stroop task. Thus CS was asked to name the display color of color words that elicited either congruent or incongruent responses. In a factorial design, Stroop congruency was crossed with synesthetic congruency (see Table). The goal was to determine the relative strength of synesthetic and reading automaticity. For example, a main effect of synesthetic congruency in the absence of a main effect of Stroop congruency or an interaction would suggest that synesthetic automaticity is relatively stronger.

Methods

The following stimuli were presented to CS and 23 non-synesthetic control participants:

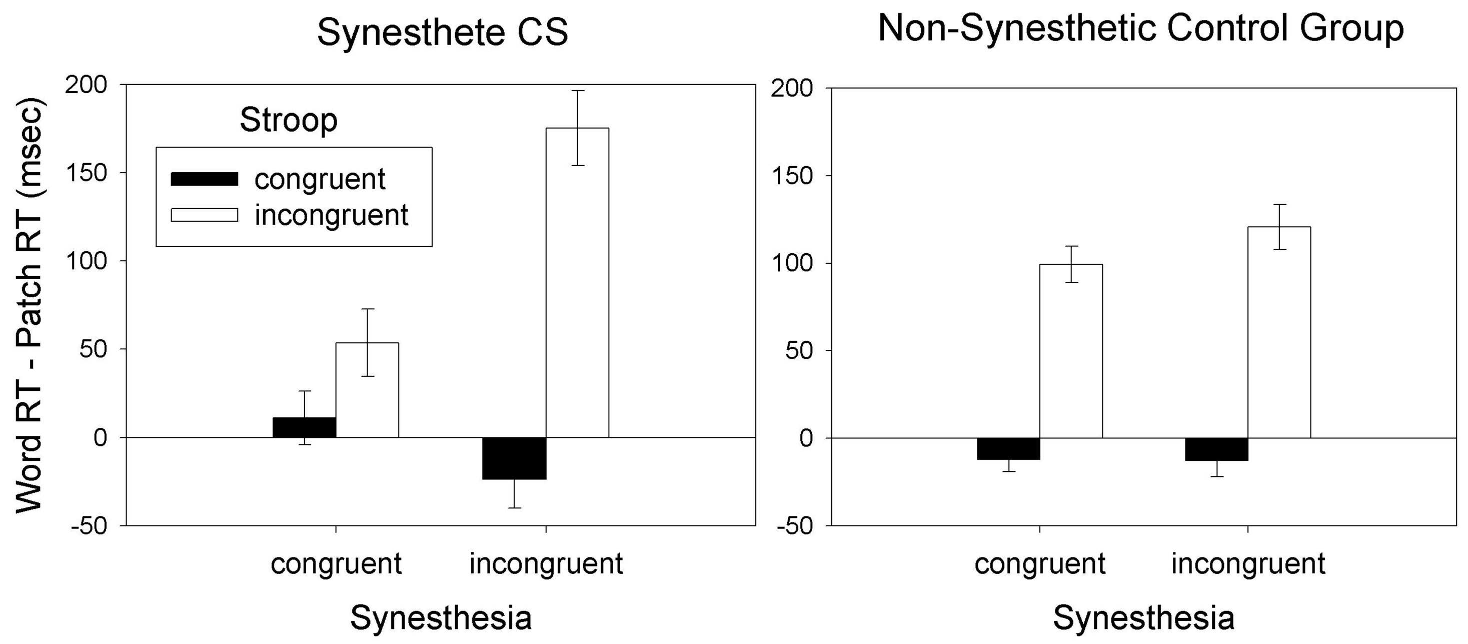
Table		Stroop	
		congruent	incongruent
Synesthesia	congruent	PINK PURPLE BLUE	ORANGE WHITE GRAY
	incongruent	ORANGE GRAY WHITE	PURPLE BLACK BLUE BROWN PINK

Participants were also presented with rectangular patches of the seven display colors, and we report the difference in color-naming RT between a stimulus and the patch of the same color. This was necessary because color-naming might be faster for one color than another (independent of the experimental manipulations), and the display colors were not equally represented in the four conditions. Note also that there were more stimuli in the incongruent-incongruent condition than in the other conditions. This was necessary to ensure that there were two stimuli for each of the display colors. For data analysis, some trials from this condition were randomly discarded, so that there were equal numbers for the four conditions.

Results

CS's data (see Figure) were submitted to a 2 x 2 independent samples ANOVA. There was a main effect of Stroop congruency ($F_{1,128} = 44.24$, $p < .001$), a main effect of synesthetic congruency ($F_{1,128} = 5.73$, $p < .05$), and an interaction ($F_{1,128} = 18.54$, $p < .001$). Further analysis of the interaction revealed a significant Stroop effect for synesthetically-incongruent stimuli ($t_{64} = 7.40$, $p < .001$), although the effect was only marginally significant for synesthetically-congruent stimuli ($t_{64} = 1.74$, $p < .10$).

The control group data (see Figure) were submitted to a 2 x 2 repeated measures ANOVA. There was only a main effect of Stroop congruency ($F_{1,22} = 105.62$, $p < .001$).



Discussion

The results suggest that synesthetic automaticity is by no means stronger than word reading automaticity. In response to the stimulus ORANGE, for example, CS was fast to say "orange", despite the fact that the stimulus elicits the synesthetic experience of white. On the other hand, the speed with which she was able to say "orange" in response to GRAY was clearly affected by the fact that the stimulus elicits the synesthetic experience of orange.

These results have interesting implications for theories of the development of synesthesia. Most contemporary theories assume a dominant role for nature and a negligible role for nurture. In other words, the automatic elicitation of color experiences by graphemes is considered something akin to a reflex. The development of reading automaticity, on the other hand, is known to be heavily dependent on nurture. One would assume that reflexive automaticity would overpower learned automaticity when the two are placed in competition. However, our results suggest that synesthetic automaticity is (at best) equal in strength to reading automaticity. This leads us to wonder whether contemporary theories have overstated the role of nature in the development of synesthetic automaticity.