

# Musical synesthesia: the role of absolute pitch in different types of pitch tone synesthesia.

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## ABSTRACT

### Background

Synesthesia is a neurological condition in which otherwise normal individuals experience two commonly independent perceptions as joined together. Namely, stimulation in one sensory modality (i.e., inducer stimulus) triggers an additional sensation in the same or other unstimulated modality (i.e., concurrent stimulus). In pitch-tone synesthesia, a musical tone evokes an additional concurrent perception in a second sense. Pitch-tone synesthesia is often associated with absolute pitch (AP), which is the ability to identify pitch tones without an external tonal context.

### Aims

We tested the importance of absolute pitch in tone-color synesthesia (TCS) and tone-space synesthesia (TSS). In tone color synesthesia, pitch chroma (e.g., *Sol*) elicits a color perception. In tone-space synesthesia, musical tones are organized explicitly in a well defined spatial array.

### Experiment 1

#### Method

In the first part of this work, AP and non-AP tone color synesthetes were presented with both auditory and visual Stroop-like tasks. In the auditory task participants were asked to name a colored patch on a screen and ignore a simultaneous presented auditory tone. In the visual task participants were asked to name the ink color of a musical note that was written the screen and ignore note identity. The synesthetical color elicited by the tone could be congruent or incongruent with the color on the screen.

#### Results and Discussion

When the musical tone was auditory (auditory Stroop like task), only AP possessors presented a congruency effect, whereas when the tone was written on the screen (visual task), both groups presented a significant congruency effect.

These results suggest that in tone-color synesthesia, additional color perception in response to musical tones is automatic and impossible to suppress. Moreover, color synesthetical association could be elicited both by auditory tones or musical notes, depending upon AP ability.

### Experiment 2

#### Method

In the second part of this work, we used a cue detection task and asked tone-space synesthete without AP and non synesthetes matched controls to detect a visual target while ignoring a simultaneous irrelevant auditory tone cue. Cue-target compatibility was manipulated according to the synesthete's diagonal spatial tone-form. Participants were asked to ignore the tone and press a key as soon as the target appeared.

#### Results and Discussion

Synesthete was slower when the auditory tone and target position were incongruent with each other compared with the congruent condition. Hence, she was unable to suppress orienting of attention to the auditory tone space form even though they did not possess AP.

#### Conclusions

The present results demonstrate the authenticity and automaticity of these types of synesthesia. Furthermore, data suggest that AP modulates the effects of tone-color but not of tone-space synesthesia. Results are interpreted considering the underlying characteristics of color perception - which is essentially categorical in nature - compared with the more ordinal nature of space.

#### Keywords

Synesthesia, tone-color synesthesia, tone-space synesthesia, Absolute pitch, Stroop, cue detection task.