A Self Organized Map Method to Classify Auditory-Color Synesthesia from Frontal Lobe Brain Blood Volume

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Abstract : Absolute pitch is the ability to identify a musical note without a reference tone. Training for absolute pitch often occurs in preschool education. It is necessary to clarify how well the trainee can make use of synesthesia in order to evaluate the effect of the training. To the best of our knowledge, there are no existing methods for objectively confirming whether the subject is using synesthesia. Therefore, in this study, we present a method to distinguish the use of color-auditory synesthesia from the separate use of color and audition during absolute pitch training. This method measures blood volume in the prefrontal cortex using functional Near-infrared spectroscopy (fNIRS) and assumes that the cognitive step has two parts, a non-linear step and a linear step. For the linear step, we assume a second order ordinary differential equation. For the non-linear part, it is extremely difficult, if not impossible, to create an inverse filter of such a complex system as the brain. Therefore, we apply a method based on a self-organizing map (SOM) and are guided by the available data. The presented method was tested using 15 subjects, and the estimation accuracy is reported.

Keywords : absolute pitch, functional near-infrared spectroscopy, prefrontal cortex, synesthesia

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