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Emotional Synergy in Music-Color Combinations: A Neurophysiological Study

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This study investigated whether combining musical and chromatic stimuli with congruent emotions produces a synergistic effect on emotional responses, measured through subjective self-reports and electroencephalography (EEG). The sample consisted of 33 participants (20 females; M = 20.3 years, SD = 2.4), all free of moderate to severe depressive symptoms (BDI-II: M = 5.5, SD = 5). Professional musicians were excluded to avoid potential biases in neurophysiological responses. Emotionally validated stimuli (n = 32) were selected, including light cyan (positive) and dark yellow (negative) from the Berkeley Color Project, along with musical excerpts with high and low emotional valence and arousal, based on prior evaluations (n = 85). Stimuli were presented in randomized order, either individually or as music-color combinations. EEG data were recorded using electrodes placed at F3, F4, P3, and P4 according to the 10/20 system, maintaining impedance levels below 5 kΩ. Preprocessing included bandpass filtering (1–30 Hz), independent component analysis (ICA) to remove ocular artifacts, and normalization of absolute power (μV^2) in theta (4–8 Hz) and alpha (8–13 Hz) bands, subtracting resting-state activity and applying natural logarithmic transformations to enhance signal-to-noise ratio. Subjective responses were collected using continuous slider scales to assess valence, arousal, pleasure, and stimulus predominance. Repeated-measures ANOVAs and nonparametric tests (W of Kendall) analyzed emotional and neurophysiological differences across experimental conditions, with corrections applied for sphericity (Greenhouse-Geisser) and effect sizes calculated (η^2 and Cohen's d). Results showed no synergistic effect between congruent music-color pairs. Subjective data indicated music as the dominant emotional stimulus, independent of its combination with congruent or incongruent colors, likely due to its greater perceptual and emotional complexity. EEG findings corroborated this, with the sad color evoking lower theta activity in the parietal region compared to more emotionally activating stimuli. This highlights the influence of stimulus complexity on emotional processing. Methodologically, this research underscores the value of integrating subjective reports with neurophysiological measures to investigate multimodal interactions. These findings have implications for affective neuroscience, virtual environments, and therapeutic applications, providing a framework for developing tools that leverage multisensory integration for emotional regulation and engagement.

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