# Music-colour synaesthesia: Sensorimotor features and synaesthetic experience

Caroline Curwen* [1], Renee Timmers [1] and Andrea Schiavio [2]
[1] University of Sheffield, UK, [2] University of Graz, Austria
ccurwen1@sheffield.ac.uk

**Disciplinary background A.** Synaesthesia: Music-colour synaesthesia is included under the umbrella term "coloured hearing" (Ward et al., 2006). Although the phenomenon is typically considered to be separate from general cognition, the shared mental processes of synaesthetes and non-synaesthetes (Simner, 2012) suggest that there may be certain similarities and differences that are a matter of degree. It is argued here that music-colour synaesthesia may share a similar grounding in action to general music cognition (Curwen, 2020).

**Disciplinary background B.** Embodied Cognition: General music cognition research has embraced embodied accounts highlighting the importance of an acting body and its engagement in the context of musical emotion, communication, participation and musical creativity (Schiavio et al., 2017, van der Schyff et al., 2018). In contrast to approaches presenting music cognition as a series of internal (i.e., computational, neural) processes and representations, these approaches propose the direct, circular interaction between the agent's body and its social, cultural, and physical environment (Reybrouck, 2014).

**Abstract**

The main aim and objective of this study is to highlight commonalities between mechanisms underlying music-colour synaesthesia and general music cognition, and to demonstrate some forms of music-colour synaesthesia are grounded in action.

Two groups (synaesthetes/non-synaesthetes) reported their experience whilst listening to 3 sets of 4 musical excerpts presented in random order:

Set 1: Excerpts played on the participant's principal instrument

Set 2: As in Set 1 but on an instrument not played by the participant before

Set 3: As in Set 1 but played on an electronic instrument, and with no expression

Participants selected and rated the applicability and intensity of terms that best described their emotional, sensorimotor/multimodal, and synaesthetic experience, and strength of their motivation to move and vocalise to the music.

It was expected that the intensity of listeners' synaesthetic experience would be influenced by a change of instrument (i.e., a change from their own instrument, to one with which they have no expertise), and there would not be a significant difference between synaesthetes and non-synaesthetes when rating emotional and sensorimotor factors across different listening conditions.

The data were subject to four types of analysis. First, a repeated measures ANOVA tested differences in emotional and sensorimotor ratings across different listening conditions between synaesthetes and controls. Second, a principal component analysis explored clustering of sensorimotor and emotional dimensions. Third, independent t-tests explored any differences between the two groups in the interrelation. Fourth, a Pearson's correlation analysis tested the relationship between sensorimotor and emotional responses, and for any difference between controls and synaesthetes.

The most influential effect on the intensity of listeners' multimodal, emotional or synaesthetic responses was whether or not music was performed by a human, more so than familiarity with a particular instrument. Synaesthetes and non-synaesthetes were shown to share a relationship between the intensity of emotional and multimodal responses, yet it was multimodal/sensorimotor intensity that was shown to be fundamentally associated with the intensity of the synaesthetic response. Overall, the results highlighted commonalities between the mechanisms underlying music-colour synaesthesia and general music cognition, and demonstrated that some forms of music-colour synaesthesia are grounded in action.

**Interdisciplinary implications.** In recent research, it has become more apparent that it is important to take into consideration that synaesthesia is not just one single condition to be explained under a 'one for all' mechanism (Simner, 2012). This research further encourages us to place synaesthesia in response to music on a continuum from "synaesthesia" to "typical music cognition" not just in perceptual terms as previously argued (Eitan, 2007; Marks, 1987) but also in sense of music cognition as an embodied phenomenon.

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