

Does The Orange Blossom Smell as Blue in Lebanon as in France? A Lebanese-French Cross-Cultural Study

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Many cross-modal correspondences involving colors have been documented in non-synesthetes. Among these cross-modal associations, a small number of studies have attempted to investigate the relationship between odors and colors (see Gilbert *et al.*, 1996; Schifferstein and Tanudjaja, 2004; Demattè *et al.*, 2006; Piqueras-Fiszman and Spence, 2011). Consistent associations between specific colors and odors mainly related to food have been confirmed recently (Maric & Jacquot, 2013). It is well known that culture-specific experiences with odors may influence different aspects of odor perception such as intensity, pleasantness or edibility. Although the cross-modal linkage between the olfactory and visual senses is seldom mentioned in the literature, it has been proved to be not only consistent but also stable with time (Gilbert, Martin, & Kemp, 1996). Interestingly, the latest research suggests that neuropsychological factors may also impact on the expression of crossmodal correspondences (Spence, 2011). As compared to visual stimuli, odors are modulating neuronal responses within the amygdala more strongly (Royet *et al.*, 2000). This preferential neuronal processing of odors in emotion generating brain areas can be explained by the strong overlap between olfactory cortex and limbic brain structures. Relationships between inner features of both olfaction and vision have been demonstrated (including odor intensity, familiarity, pleasantness and edibility). In addition the effect of culture does play an important role through this inter-modal correspondence: Japanese perceive differently odors than Germans (Ayabe-Kanamura *et al.*, 1998).

To further investigate the influence of experience on odor-color correspondences, the responses of 155 French and 96 Lebanese subjects to the same odorants were compared. In each country, untrained subjects were first presented with 16 food and flower natural odorants and asked to select among 24 colours the one that best matched each given olfactory stimulus. Secondly, they rated each odor according to four descriptors (intensity, familiarity, pleasantness and edibility).

Both populations matched olfactory stimuli with colors in a non-random manner. Indeed, significant color characterizations were found for all tested odors. For 12 odors, no significant differences were found between French and Lebanese subjects in all the matched colors. For 3 odors, no clear differences between the two populations were found in the mainly associated color. Somewhat unexpectedly, significant differences in colors association were only found for one odorant: orange blossom. Furthermore, a significant difference was found between the two populations in edibility ratings for this odor. This difference could therefore arise from cultural differences in the odor function.

Our results confirm the existence of robust odor-color correspondences among both populations and raise important questions about the representation of odors. This underlines the need for further studies to understand the mechanisms underlying these cross-modal correspondences and the influence of cultural background and experience on them.