Our sense of smell alters the colors we see, show scientists

October 6 2023, by Mischa Dijkstra

Credit: Unsplash/CC0 Public Domain

Our five senses bombard us with environmental input 24/7. One way our brain makes sense of this abundance of information is by combining information from two or more senses, such as between smells and the

smoothness of textures, pitch, color, and musical dimensions. This sensory integration also causes us to associate higher temperatures with warmer colors, lower sound pitches with less elevated positions, and colors with the flavor of particular foods—for example, the taste of oranges with the color of the same name.

Now, a study in *Frontiers in Psychology* has shown experimentally that such unconscious 'crossmodal' associations with our sense of smell can affect our perception of colors.

"Here we show that the presence of different odors influences how humans perceive color," said lead author Dr. Ryan Ward, a senior lecturer at Liverpool John Moores University in Liverpool, UK.

Sensory-deprived room

Ward and colleagues tested for the existence and strength of odor-color associations in 24 adult women and men between 20 and 57 years of age. The participants were seated in front of a screen in a room devoid of unwanted sensory stimuli for the duration of the experiments. They wore no deodorants or perfumes, and none reported being color-blind or having an impaired sense of smell.

All ambient odors in the isolation room were purged with an air purifier for four minutes. Then one of six odors (chosen at random from caramel, cherry, coffee, lemon, and peppermint, plus odorless water as a control) was broadcast into the room with an ultrasonic diffuser for five minutes.

"In a previous study, we had shown that the odor of caramel commonly constitutes a crossmodal association with dark brown and yellow, just like coffee with dark brown and red, cherry with pink, red, and purple, peppermint with green and blue, and lemon with yellow, green, and

pink," explained Ward.

Participants were presented with a screen that showed them a square filled with a random color (from an infinite range) and were invited to manually adjust two sliders—one for yellow to blue, and another for green to red—to change its color to neutral gray. After the final choice had been recorded, the procedure was repeated, until all odors had been presented five times.

Overcompensating for unconscious associations

The results showed that participants had a weak but significant tendency to adjust one or both of the sliders too far away from neutral gray. For example, when presented with the odor of coffee, they wrongly perceived 'gray' to be more of a red-brown color than true neutral gray. Likewise, when presented with the odor of caramel, they wrongly perceived a color enriched in blue as gray. The presence of the smell thus distorted the participants' color perception in a predictable manner.

An exception was when the odor of peppermint was presented: here, the participants' choice of hue was different from the typical crossmodal association demonstrated for the other odors. As expected, the participants' selection likewise corresponded to true gray when presented with the neutral scent of water.

"These results show that the perception of gray tended towards their anticipated crossmodal correspondences for four out of five scents, namely lemon, caramel, cherry, and coffee," said Ward.

"This 'overcompensation' suggests that the role of crossmodal associations in processing sensory input is strong enough to influence how we perceive information from different senses, here between odors and colors."

Questions remain

The researchers emphasize the need to investigate how far-reaching such crossmodal associations between odors and colors are.

"We need to know the degree to which odors influence color perception. For example, is the effect shown here still present for less commonly encountered odors, or even for odors encountered for the first time?" said Ward.

More information: Ryan J. Ward et al, Odors modulate color appearance, *Frontiers in Psychology* (2023). DOI: 10.3389/fpsyg.2023.1175703

Provided by Frontiers