

Cigarette package colour is associated with level of filter ventilation

The cigarette package is, in many markets, the primary means of marketing and advertising cigarette brands to consumers. While some countries have moved to implement plain packaging, most continue to allow product differentiation on the basis of packaging. Colour is often used to communicate implicit messages about taste, risk and quality, and evidence suggests that package colours are specifically chosen to manipulate consumer perceptions through 'sensation transference'.¹ Filter ventilation also has been shown to influence perceptions of harshness and perceived risk.^{2,3} Filter ventilation is also closely associated with machine-measured tar yield and is generally higher in brands previously marketed as 'Light'. Light and similar words have in many cases been supplanted by colours or other descriptive terms.⁴ Bans appear to have had an effect in reducing false beliefs, but substantial levels of false beliefs persist, most likely due to other cues that remained, including replacement descriptors, colour-coded packs and filter ventilation.^{5,6} Using a large database of packages, we explored the extent to

which package colour is related to filter ventilation.

Data for 759 brands purchased in 16 countries from November 2008 to March 2010 were available. Brands were purchased in countries that were participating in the International Tobacco Control Evaluation Project (see www.itcproject.org): Brazil, Canada, China, UK, USA, Malaysia, France, Mexico, Netherlands, New Zealand, Germany, Australia, India, Ireland, South Korea, Bangladesh and Russia. Packs were purchased at three retail outlets in each country, and included all available varieties for 10 leading brand families in each country. Brand families were selected based on market share data, where available. Filter ventilation (0%–100%) was tested using a KC-3 apparatus (Borgwaldt KC, Richmond, Virginia, USA) and reported as the average of 10 cigarettes. Cigarette packs were optically scanned, and the primary or dominant pack colour was quantified in the three-dimensional HSB (hue, saturation, brightness) system using Photoshop Elements. Hue is the nominal colour, expressed in degrees (0–360; by convention red=0). For analysis, hue values were categorised as recognisable colours (red, orange, yellow, green, blue, purple, white, grey, black). Saturation describes the depth of colour (0%–100%, where 0 is neutral), while brightness describes the amount of illumination (0%–100%, where

0 is black). Data were assessed graphically and via generalised linear models (GLM) (Tweedie distribution, identity link function, maximum likelihood estimation) in SPSS V.21.0.

Across packages, the median brightness value was 79.0 (IQR: 62–90) and the median saturation value was 22.0 (IQR: 7–72). The median filter ventilation level was 29.2%. The most common hues were blue (29.8%), red (23.7%), orange (10.1%) and green (9.7%). **Figure 1** plots ventilation (z) as a function of saturation (x) and brightness (y) in three dimensions, with individual cases identified by their hue. Among this sample of international cigarette brands, quantified pack colour characteristics (saturation, $r=-0.32$; brightness, $r=0.26$) were associated with ventilation. In effect, more highly ventilated cigarettes were packaged with brighter, less saturated colours. Our GLM analysis showed that, controlling for country, hue ($\chi^2(8)=52.78$, $p<0.001$), saturation ($B=-0.053$, $p=0.009$) and brightness ($B=0.073$, $p=0.007$) were all independently associated with filter ventilation. Higher ventilation was associated with less colour saturation and greater brightness. Deviance contrasts on hue showed that black (-9.42 , $p=0.001$ with Sidak correction) and red (-4.17 , Sidak $p=0.045$) packs were significantly below the grand mean of ventilation (29.76, SE 0.97), while grey packs ($+11.48$, Sidak

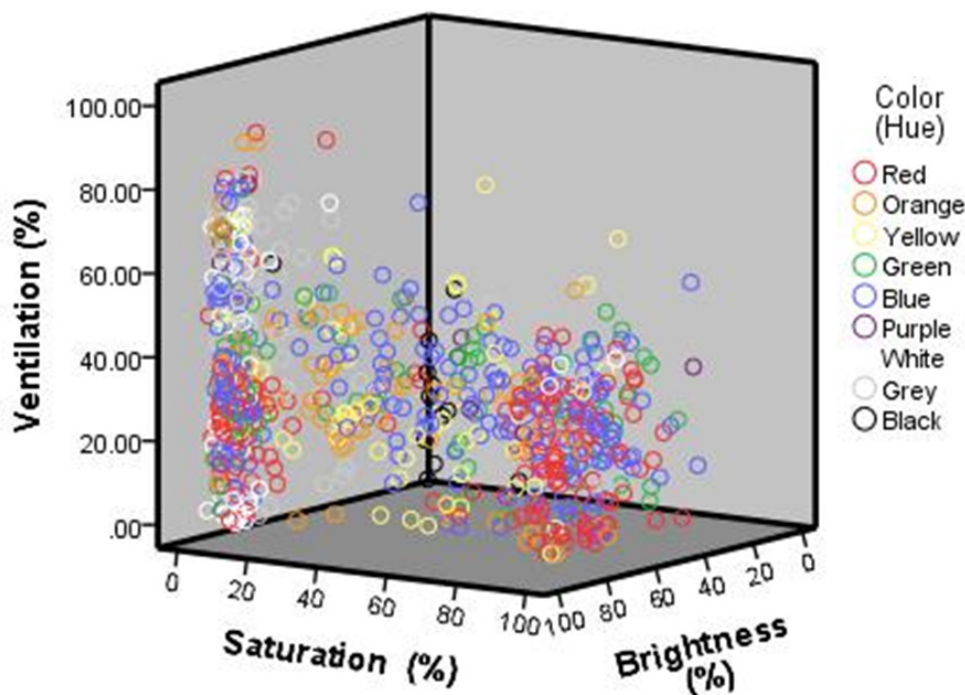


Figure 1 Relationship of pack colour characteristics to filter ventilation level, international brands.

$p=0.001$) were significantly above the grand mean.

Recent reports have highlighted the role of package colour in shaping consumer perceptions.¹ The current findings highlight the interaction of product design and brand imagery as communicated through packaging. Because the smoke from 'light' cigarettes is diluted by air entering through the filter vents, lower tar cigarettes actually produce a 'lighter', less harsh taste when inhaling smoke.^{2,3} For consumers, the 'lighter' sensory perceptions are perceived as physiological validation of the information conveyed in marketing messages and lower tar numbers: 'light' cigarettes must be less harmful because they could taste the difference. Indeed, many consumers use the taste or 'strength' of a brand as an indicator of its relative level of harm.⁷ Pack colours (particularly red and black) appear to convey this. The effect of marketing restrictions, such as plain packaging regulations, on consumer risk perceptions could be limited if the underlying design of products remains unchanged. On the other hand, removing colour as a distinguishing feature across packs could also help to disrupt the observed link between packaging elements and filter ventilation. Combining plain or standardised packaging with restrictions on

cigarette design could enhance the effect of labelling regulations.

Richard J O'Connor,¹ David Hammond²

¹Department of Health Behavior, Roswell Park Cancer Institute, Buffalo, New York, USA

²School of Public Health and Health Systems, University of Waterloo, Waterloo, Canada

Correspondence to Professor Richard J O'Connor, Department of Health Behavior, Roswell Park Cancer Institute, Elm and Carlton Streets, Buffalo 14226, New York, USA; richard.o'connor@roswellpark.org

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Competing interests DH has provided paid expert testimony on behalf of public health authorities in response to legal challenges from the tobacco industry, including on packaging and labelling regulations.

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