



Coloration in different areas of facial skin is a cue to health: The role of cheek redness and periorbital luminance in health perception



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ABSTRACT

Looking healthy is a desirable trait, and facial skin color is a predictor of perceived health. However, skin conditions that cause dissatisfaction with appearance are specific to particular facial areas. We investigated whether color variation in facial skin is related to perceived health. Study 1 defined three areas based on color differences between faces perceived as healthy or unhealthy: the forehead, periorbital areas, and the cheeks. Periorbital luminance and cheek redness predicted perceived health, as did global skin yellowness. In Study 2, increased luminance and redness caused faces to be perceived as healthier, but only when the increase was in the periorbital and cheek areas, respectively. Manipulating each area separately in Study 3 revealed cheek redness and periorbital luminance equally increased perceived health, with low periorbital luminance more negatively affecting perceptions. These findings show that color variation in facial skin is a cue for health perception in female faces.

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Introduction

The idea that our faces reflect our health is a notion that dates back centuries (Bridges, 2012), and having a healthy appearance is universally desired. Appearing healthy contributes to a number of factors that influence attractiveness (Rhodes et al., 2007), which in turn strongly affects self-esteem (Feingold, 1992), and individuals who appear healthy are more likely to be selected as leaders across different scenarios, even compared to those who appear intelligent (Spisak, Blaker, Lefevre, Moore, & Krebbers, 2014). Clearly, a healthy appearance is a trait with important social outcomes, as well as personal outcomes relating to body image. But what makes a face appear healthy? Here, we describe work investigating whether variation in skin color between different parts of the face is a cue for perceiving health.

Though attributes of facial shape, such as facial adiposity, are cues to health (Coetsee, Perrett, & Stephen, 2009; Coetsee, Re, Perrett, Tiddeman, & Xiao, 2011), most research on facial health perception has focused on skin properties. Indeed, observers can accurately identify composite faces made of individuals with high or low self-reported health, even when shape cues are removed; skin property cues are all that are required for accurate identification of health (Jones, Kramer, & Ward, 2012). One skin property that is important for health perception is the evenness, or homogeneity, of the skin tone. With shape invariant faces, an even skin color distribution (e.g., an absence of dark spots or blemishes) predicts perceived health (Fink, Grammer, & Matts, 2006), and smoothing color distribution increases perceived health in natural faces (Samson, Fink, & Matts, 2011). An even color distribution visible in small snapshots of skin is able to predict global ratings of facial health (Matts, Fink, Grammer, & Burquest, 2007), as well as attractiveness (Jones, Little, Burt, & Perrett, 2004).

At a more holistic level, the overall color of the skin is another important cue to perceived health. Observers perceive faces with lighter, redder, and yellow skin as healthier looking (Stephen, Law Smith, Stirrat, & Perrett, 2009). These colorations are linked to biological traits relevant to health. For example, observers judge faces with higher levels of redness healthier, if that redness comes from oxygenated blood (Stephen, Coetsee, Law Smith, & Perrett, 2009). Lower levels of this coloration suggest reduced blood flow to the

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skin, which is associated with respiratory or cardiovascular illness (Ponsonby, Dwyer, & Couper, 1997). Facial redness may, therefore, act as a cue to the cardiovascular health of an individual. Recent research has highlighted the importance of skin color in perceiving health by examining its interaction with shape cues (Fisher, Hahn, DeBruine, & Jones, 2014). While low levels of adiposity may appear healthy, it might also indicate illness. Low levels of adiposity alongside yellower or redder skin is perceived as much healthier than in faces with reduced coloration and adiposity, suggesting that skin coloration may be a particularly important cue to health (Fisher et al., 2014). Increases in facial temperature are observed with social interactions with members of the opposite sex and may lead to increased redness in the face that may increase attractiveness (Hahn, Whitehead, Albrecht, Lefevre, & Perrett, 2012). Cheek redness increases with higher levels of estradiol (Jones, Hahn, et al., 2015), which is associated with fertility. This cheek redness may then be related to perceptions of health and attractiveness (Samson et al., 2011; but see Burriss et al., 2015). Higher levels of yellowness in facial skin can be caused by carotenoids, which come from a diet rich in fruit and vegetables (Stephen, Coetzee, & Perrett, 2011; Whitehead, Re, Xiao, Ozakinci, & Perrett, 2012). Higher levels of luminance in facial skin (i.e., lighter skin) are also associated with perceived health in both Black South African and Caucasian U.K. faces (Stephen et al., 2011; Stephen, Law Smith, et al., 2009).

There are also social accounts of how skin color may influence health. In Latin Americans, increasingly darker skin is associated with poorer self-reported health, a relationship mediated by exposure to class discrimination and socio-economic status (Perreira & Telles, 2014). Related, lighter skin in women from African and Mexican American samples predicts higher educational attainment and personal income (Hunter, 2002) and skin color is a predictor of chronic stress, blood pressure, and higher body mass index (BMI) in young African American women (Armstead, Hébert, Griffin, & Prince, 2014). These findings suggest social responses to skin affect health and health-related behaviors, which coupled with our skin reflecting our biological health represents a complex interaction in which skin plays a primary role (Jablonski, 2012).

While work on facial health perception has found evidence that overall skin color is a cue for perceived health (Stephen et al., 2011), and that variation in skin color at a fine, textural scale (i.e., skin homogeneity) is also important (Matts et al., 2007), it is not known whether variation in coloration in different parts of the face is a cue to perceived health. The work examining the role of overall skin color in perceived health (Stephen, Coetzee, et al., 2009; Stephen et al., 2011; Whitehead et al., 2012) has utilized point-source measurements from spectrophotometers to measure skin coloration. While this measure accurately captures coloration from a single point (often less than a centimeter), it provides limited information about spatial variation in coloration. Interestingly, many people are dissatisfied with their facial appearance due to uneven coloration. For example, the characteristic redness present in the skin condition rosacea is partially the result of elevated levels of blood flow (Sibenge & Gawkrödger, 1992) and susceptibility to flushing (Wilkin, 1994), and affects health-related quality of life in sufferers (Balkrishnan et al., 2006). Similarly, periorbital circles – or ‘dark circles under the eyes’ – have a range of causes, such as dermal melanin deposition (Freitag & Cestari, 2007), and are also a cosmetic concern affecting quality of life in individuals of all ages (Roh & Chung, 2009). Moreover, darker coloration in this area is increased by a lack of sleep, which has a negative impact on perceived health (Axelsson et al., 2010). Related, elevated skin yellowness is correlated with health issues such as jaundice (Knudsen & Brodersen, 1989), indicating that healthy coloration (yellowness in the case of jaundice or redness in the case of rosacea) beyond a certain range can be perceived as unhealthy.

Evidence from grooming behaviors suggests that coloration in different facial areas is relevant for health perception. Specifically, there are at least two cosmetics practices that target and improve the appearance of the periorbital and cheek areas. Foundation and concealer are applied to the periorbital region and blush is applied to the cheeks; this is likely a partial cause of faces being rated as healthier with cosmetics than without (Nash, Fieldman, Hussey, Lévesque, & Pineau, 2006). Cosmetics are also related to body image issues, with individuals with higher anxiety and self-presentation concerns wearing more cosmetics (Robertson, Fieldman, & Hussey, 2008). Cosmetics may serve to alter the coloration in the areas that individuals are dissatisfied with, contributing to a healthier appearance, consistent with the notion that a primary function of cosmetics is as a tool for camouflage for decreasing negative self-perceptions of attractiveness (Korichi, Pelle-de-Queral, Gazano, & Aubert, 2011).

Based on the cosmetic concerns of those with discoloration in different face regions and the relationships between these discolorations and actual health (Freitag & Cestari, 2007; Roh & Chung, 2009), we hypothesize that the color of particular regions of the skin contribute differently to the perception of health from the face. To test this hypothesis, we began by conducting an exploratory analysis of regional color differences between faces rated as healthy and those rated as unhealthy. We found such differences in the cheek and periorbital regions and confirmed their relationship to perceived health. In a subsequent series of experiments, we manipulated the color of these regions directly to examine whether it would change the perceived health of the faces, implicating the color of these regions as cues for the perception of health from the face.

Study 1

In order to determine whether skin color associated with health varies spatially across the face, we first sought to visualize the differences in color between faces that are perceived as healthy and those perceived as unhealthy. To do this, we compared average images derived from faces perceived as healthy or unhealthy. We utilized a sample of female faces from an older age demographic than is typically used in health perception research, given that we wished to examine a range of healthy appearances. A sample of older women is advantageous as there are likely a wider range of appearances in this age group, reflecting differential life experiences and factors, compared to a relatively homogenous appearance that may be found in younger adult faces. From examination of these difference images, we derived regions of interest and examined whether color values in these areas could predict ratings of health assigned to faces.

Method

The experimental procedures and participant recruitment used in the following study were approved by the Institutional Review Board (IRB) at Gettysburg College.

Models. One hundred and forty six French Caucasian women (56–60 years, $M = 58.10$, $SD = 1.40$) participated as models. All were photographed with a Canon EOS-1 Ds MII camera. Faces were illuminated using diffuse lighting in front and direct flashes from 45° from both sides. All traces of jewelry and cosmetics were removed before models were photographed with a neutral expression, looking directly at the camera. Models were informed before being photographed that their participation was part of a study aiming to increase understanding of the skin and facial appearance related to

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