

## Does facial attractiveness really signal immunocompetence?

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**Abstract.** The dominant theory of facial attractiveness judgments is that they evolved to identify healthy individuals with strong immune systems. We summarize results of recent tests of this hypothesis, concluding that it has little compelling empirical support. We then propose an alternative perspective that emphasizes the effects of lifestyle health.

**Main text.** Facial attractiveness judgments largely transcend culture and influence important social decisions. For example, facial attractiveness influences our choice of romantic partner, who we choose to vote for, and who we choose to employ. Consequently, there is a large interdisciplinary literature investigating the factors that determine facial attractiveness and the reasons for high consensus in facial attractiveness judgments. The most dominant theory of facial attractiveness is the hypothesis that attractiveness judgments are cognitive adaptations that evolved to identify potential mates with strong immune systems (i.e., individuals who will produce particularly healthy offspring) [1].

Early research testing this immunocompetence hypothesis investigated putative relationships between attractiveness ratings of face photographs and the number of infectious illnesses the photographed individuals reported having experienced. Consistent with the immunocompetence hypothesis, many (though not all) of these studies reported that individuals with more attractive faces reported experiencing fewer infectious illnesses [reviewed in 2].

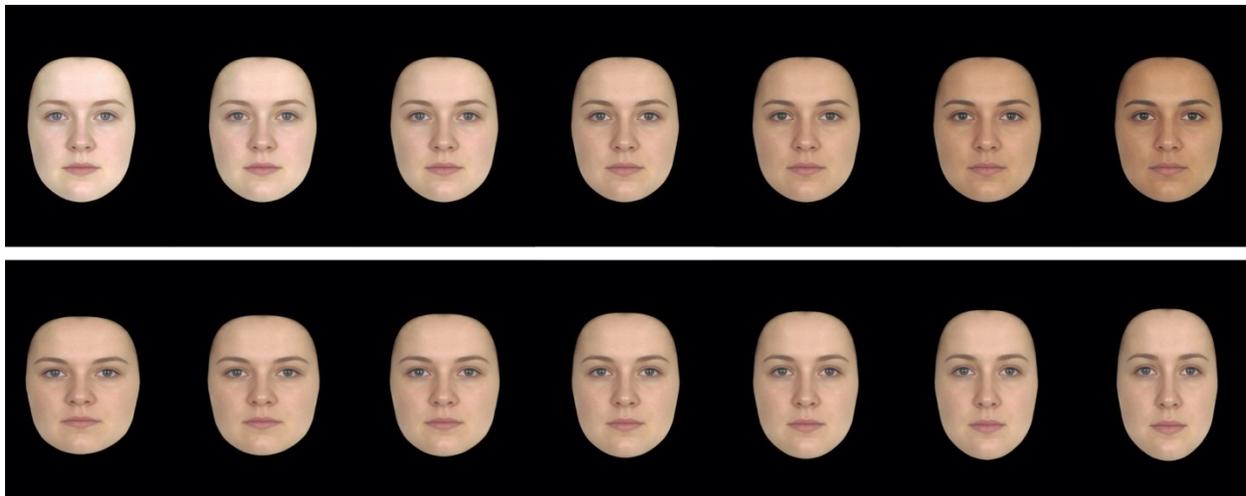
These studies might appear to provide compelling evidence for the immunocompetence hypothesis of facial attractiveness. However, they relied on self-reported experience of infectious illnesses, an indirect measure of immunocompetence which is prone to biases in reporting. To address this methodological limitation, more recent studies have investigated the relationship between facial attractiveness and immunocompetence using direct measures of immune function [2-4,6,7], such as the magnitude of immune responses to vaccinations, antibacterial and lysozyme activity in saliva, and immunoglobulin A secreted in saliva.

Two of the first studies to undertake this type of more direct test of the immunocompetence hypothesis investigated the relationship between facial attractiveness and immune response to a hepatitis vaccination in samples of women [3] and men [4]. These results suggested that men, but not women, with more attractive faces showed stronger immune responses. However, other physiological correlates of male facial attractiveness reported in this same sample of men (e.g., interactions between the effects of cortisol and testosterone on facial attractiveness) have not been

observed in replication studies [e.g., 5]. It is therefore unclear whether the correlation between immunocompetence and facial attractiveness reported in men in this sample would generalize to other samples.

Other recent studies have found little compelling evidence for associations between facial attractiveness and immune response. For example, one study [6] observed no significant associations between attractive characteristics in men's and women's faces and salivary measures of innate immune response (antibacterial and lysozyme activity). Similarly, another study [2] observed no significant associations between women's facial attractiveness and levels of Immunoglobulin A secreted in saliva, a measure of immune response commonly used in non-human primate and human studies. Despite having a very large sample, this latter study also did not replicate previous findings that women with more attractive faces reported having experienced fewer infectious illnesses.

Another recent study found that men and women who had stronger immune systems in adolescence had more masculine and feminine face shapes in adulthood [7]. Although these findings might initially appear to support the immunocompetence hypothesis, multiple lines of evidence now indicate that masculine and feminine face shapes contribute very little to attractiveness judgments [8,9]. For example, femininity of face shape explained only ~11% of the variance in ratings of women's facial attractiveness, whereas a model derived from Principal Component Analysis of face shape and coloration explained ~40% [9]. Indeed, multiple lines of evidence suggest that other facial characteristics often theorized to signal aspects of health such as immunocompetence (e.g., symmetric or prototypical face shapes, individual color axes) are actually poor predictors of facial attractiveness [2, 8-10]. Figure 1 shows visualizations of components that were key predictors in a recent study that used a data-driven, rather than theory-driven, approach to investigate correlates of women's facial attractiveness.



**Figure 1. Visualizing predictors of facial attractiveness.** Figure shows visualizations (adapted from [9]) of the color (top row) and shape (bottom row) components that were the best predictors of attractiveness in a recent data-driven study that used women's

faces as stimuli. Visualizations span a range of +/- 3 standard deviations from the mean (the centre face in each row). Visualizations are applied to a prototype manufactured from all face images tested in the study (i.e., the mean shape and color for the sample). The color component appears to represent unhealthy-looking pallor versus healthy-looking glow and had a positive linear relationship with attractiveness. The shape component appears to represent wide short face versus long thin face and had a curvilinear relationship with attractiveness. The color component is similar to aspects of facial coloration that are influenced by fruit and vegetable consumption and the shape component is similar to aspects of facial shape that are related to body mass index.

In addition to predicting a correlation between immunocompetence and facial attractiveness, a second critical prediction of the immunocompetence hypothesis is that individuals with attractive faces will have greater mating success (e.g., obtain more sexual partners) as a consequence of signalling their stronger immune systems. A recent study directly testing this hypothesis found that facial attractiveness predicted measures of men's, but not women's, mating success, but also found that salivary measures of immune response were not significantly related to measures of mating success [11]. These results are again inconsistent with the central predictions of the immunocompetence hypothesis.

Collectively the findings described above suggest there is little compelling empirical evidence to support the immunocompetence hypothesis of facial attractiveness. Consequently, we suggest that researchers should focus on developing and testing alternative models. Notably, this suggestion is also consistent with the results of recent studies that found little empirical evidence for putative associations between other markers of underlying physical condition (semen quality, oxidative stress assessed from saliva) and either attractive facial characteristics [e.g., 5] or measures of mating success [e.g., 11].

What alternatives to the immunocompetence account of facial attractiveness are there? One intriguing possibility is that, rather than reflecting immunocompetence, facial attractiveness is instead more closely linked to aspects of lifestyle that produce health benefits. For example, several lines of evidence suggest that improving diet health by increasing fruit and vegetable consumption will improve facial attractiveness through its positive effects on the perceived health of facial coloration [e.g., 12]. Moreover, body mass index is known to be sensitive to lifestyle health and is a better predictor of facial attractiveness than immune responses [2].

An important advantage of considering the effects of lifestyle and health-related behaviors on facial appearance is that, because they can (and often do) change over even relatively short periods of time, considering lifestyle factors in our understanding of facial attractiveness can accommodate the high degree of within-person variability in facial attractiveness that has been observed in some work. Text Box 1 outlines potential mechanisms through which lifestyle health might contribute to changes in facial attractiveness.

Notably, focusing research efforts on clarifying the aspects of lifestyle that are critical for facial attractiveness could also have important public health implications. For example, using computer graphic methods to model the positive effects of increased fruit and vegetable consumption on facial appearance has been shown to be an effective intervention for improving diet, particularly in young adults [12]. Thus, focusing research effort on better understanding the links between lifestyle and facial attractiveness could not only increase our understanding of the factors that shape a critical driver of social perceptions and stereotypes, but might also illuminate novel approaches to improving public health.

What are the gaps in our knowledge about how lifestyle health is related to facial attractiveness? While most research on this topic has focused on individual components of lifestyle health (e.g., diet), research considering multiple aspects of lifestyle health simultaneously is needed to establish the aspects of lifestyle health that best predict attractiveness and the extent to which altering these different aspects of lifestyle alters facial appearance. Ideally, such research would also directly compare the importance of lifestyle health and measures of immunocompetence, as well as other factors that are thought to influence attractiveness (e.g., the photographed individual's reproductive capacity, absence of short-term sickness, or the perceptual fluency of the stimuli). Research is also needed to identify whether some individuals' facial appearance is more sensitive to lifestyle changes than others and, if so, the factors that determine this variability. Relatedly, work is needed to identify whether lifestyle-predictors of a healthy, attractive facial appearance vary across, or transcend, cultures. More fundamentally, we suggest that, while the majority of research into facial attractiveness has focused exclusively on understanding factors that determine variation in facial attractiveness that occurs *between* individuals, identifying factors that shape variation in facial attractiveness that occurs *within* individuals is critical to obtaining a complete understanding of why some faces are judged to be more attractive than others.

**Text Box 1. Linking lifestyle health to facial appearance.** Recent work using data-driven approaches to identify key predictors of facial attractiveness suggest that healthy levels of adiposity and healthy-looking coloration (i.e., absence of pallor) are key predictors of facial attractiveness (see, e.g., Figure 1). These are both characteristics that are sensitive to changes in lifestyle health. For example, increasing fruit and vegetable consumption increases healthy-looking facial coloration and healthy levels of exercise produce healthy levels of facial adiposity. We suggest that the effects of lifestyle on facial coloration and facial adiposity may be key mechanisms for linking lifestyle to attractiveness and might play a particularly important role in explaining within-individual variation in attractiveness. Other facial characteristics associated with lifestyle health could include those associated with general wellbeing and mood, such as demeanour, cues to alertness, and postural cues, such as head-tilt.

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