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No evidence that facial attractiveness, femininity, averageness, or coloration are cues to susceptibility to infectious illnesses in a university sample of young adult women

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Abstract

Previous reports that women with attractive faces are healthier have been widely cited as evidence that sexual selection has shaped human mate preferences. However, evidence for correlations between women's physical health and facial attractiveness is equivocal. Moreover, positive results on this issue have generally come from studies of self-reported health in small samples. The current study took standardized face photographs of women who completed three different health questionnaires assessing susceptibility to infectious illnesses (N=590). Of these women, 221 also provided a saliva sample that was assayed for immunoglobulin A (a marker of immune function). Analyses showed no significant correlations between rated facial attractiveness and either scores on any of the health questionnaires or salivary immunoglobulin A. Furthermore there was no compelling evidence that objective measures of sexual dimorphism of face shape, averageness of face shape, or facial coloration were correlated with any of our health measures. While other measures of health may yet reveal robust associations with facial appearance, these null results do not support the prominent and influential assumption that women's facial attractiveness is a cue of young adult women's susceptibility to infectious illnesses, at least in our study population.

Introduction

Reports that young adult women with attractive faces are healthier are widely cited as evidence that sexual selection shaped facial attractiveness judgments and mate preferences (Grammer et al., 2003; Little et al., 2011a; Thornhill & Gangestad, 1999). However, although some studies have found that women with more attractive faces report fewer past health problems (Hume & Montgomerie, 2001; Gray & Boothroyd, 2012; Little et al., 2011b; Shackelford & Larsen, 1999), other studies have not replicated these findings (Kalick et al., 1998; Thornhill & Gangestad, 2006).

Studies examining more objective measures of women's health have also reported mixed results. For example, although one study (Rantala et al., 2010) reported that women with relatively unattractive faces in a poorer Western country had higher cortisol (a potential marker of immunosuppression) subsequent studies carried out in highly developed Western countries did not replicate this finding (Gonzalez-Santoyo et al., 2015; Han et al., 2016). Additionally, Foo et al. (2017) found that biomarkers of health (oxidative stress and composite measures of immune function) were not significantly correlated with women's facial attractiveness.

Because of these mixed results for measures of young adult women's susceptibility to infectious illnesses and facial attractiveness, the current study tested for putative relationships between women's facial attractiveness and (1) their responses on three health questionnaires assessing health problems (Ns=582, 583, 572) and (2) salivary Secretory Immunoglobulin A (SIgA,

N=221). SIgA is the main immunoglobulin found in mucous secretions from the salivary glands and, because it acts as a defense against microbial invasion (Bosch et al., 2011), is widely used as a marker for immune function (Higham et al., 2010; Van Anders, 2010). SIgA influences immunity through two main routes (reviewed in Mantis et al., 2011). First, it prevents pathogens entering the intestinal epithelium (immune exclusion). Second, it suppresses bacterial activity (direct effect on bacterial virulence). Recent work investigating potential relationships between vocal characteristics and health in humans has also used SIgA as a marker of susceptibility to infectious illnesses (Arnocky et al., 2018). The samples in our study are considerably larger than the largest used in published tests for correlations between women's facial attractiveness and health-questionnaire responses (N=203, Thornhill & Gangestad, 2006) or biomarkers of women's health (N=96, Han et al., 2016).

Thornhill and Gangestad (2006) reported that healthier women had more feminine face shapes. By contrast, Jones (2018) reported that healthier women (assessed from responses on health questionnaires) had more average (i.e. prototypical) face shapes. Thus, correlates of facial attractiveness (face-shape sexual dimorphism or averageness), rather than facial attractiveness *per se*, may be related to health. Consequently we also tested for correlations between each of our health measures and two objective measures of face-shape sexual dimorphism and one objective measure of face-shape averageness. Because some researchers have suggested facial coloration is a health cue (reviewed in Jones, 2018), we also

tested for possible correlations between components of facial coloration and each our health measures.

Methods

Participants

Five hundred and ninety women (all attending University of Glasgow; mean age=21.48 years, SD=3.24 years, 98% White, one woman did not report her age) participated as part of a larger project on hormones and mating psychology (Jones et al., 2018a, 2018b, 2018c). All women provided written informed consent.

Face photography

Face images of all 590 women were taken under standardized photographic conditions. Each woman first cleaned her face with hypoallergenic face wipes to remove any makeup. A full-face digital photograph was taken a minimum of 10 minutes later. Participants posed with a neutral expression. Photographs were taken in a small windowless room against a constant background and under standardized diffuse lighting conditions. Camera-to-head distance and camera settings were held constant. A white smock covered clothing when participants were photographed. Photographs were taken using a Nikon D300S digital camera and a GretagMacbeth 24-square ColorChecker chart was included in each image for use in color calibration. Images were color calibrated using a least-squares transform from an 11-expression polynomial expansion developed to standardize color information across images (Hong et al., 2001), aligned on pupil positions, and masked so hairstyle was not visible.

Attractiveness ratings

Images were rated for attractiveness on a 1 (very unattractive) to 7 (very attractive) scale by 16 men and 16 women (mean age of raters = 23.50 years, SD = 3.83 years; one rater did not report her age; all students at University of Glasgow, 78% White). Trial order was fully randomized and the screen was calibrated using an xRite i1 Display Pro colorimeter. Raters were not told the purpose of the study prior to rating, rated all faces in a single block (with self-paced breaks), Cronbach's alpha for ratings was .93, and men's and women's ratings were highly correlated (rho=.88, N=590, p<.001). Consequently, we calculated the mean attractiveness rating for each image (M=2.98 SD=0.71).

Sexual dimorphism of face shape

Face-shape sexual dimorphism was measured from each photograph using a discriminant analysis method (Lee et al., 2014) and a vector analysis method (Holzleitner et al., 2014). These derive shape components from principal component analysis of landmarks to measure the probability of the face being classified as male (discriminant analysis method) or to locate the face on a female-male continuum (vector analysis method). Code for calculating these sexual dimorphism scores is available at https://osf.io/98qf4/. Higher scores indicate more masculine face shapes. An additional 50 male (Mean age=20.85 years, SD=3.01 years) and 50 female (Mean age=20.60 years, SD=1.38 years) faces (all students at University of Glasgow) were used to build the model used to calculate these scores.

Averageness of face shape

Face-shape averageness was measured from each photograph using a technique described in Lee et al. (2016). This method derives shape components from principal component analysis of landmarks to measure the distance the face lies from the mathematical average shape for the sample of faces. Higher scores indicate more distinctive face shapes. Code for calculating distinctiveness scores is available at https://osf.io/98qf4/.

Measuring facial coloration

To assess facial color information, the shape of each face image was first transformed to the average face shape for the sample. This was done to ensure skin patches were sampled from homologous regions across individuals. Skin patches (200 x 200 pixels) were defined in the same location on both left and right cheeks. Color values were calculated on the three axes of the CIELab color space using R's colorspace package (Ihakaet al., 2016). Color values correspond to the mean luminance (L*), red (a*), and yellow (b*) values from both cheek patches. CIELab color space was designed to approximate all perceivable colors in human vision and has been used in previous research on facial coloration (e.g., Jones et al., 2015).

Health questionnaires

Each woman completed Stevenson et al's (2009) infection frequency and recency questionnaire, which consists of two subscales that assess the frequency with which the participant has suffered from different infectious illnesses (e.g. colds ear infections) in the previous year (the infection frequency subscale; M=9.21, SD=5.48) and how long ago the most recent

occurrence of each infectious illness was (the infection recency subscale; M=15.13, SD=5.36). We chose this questionnaire because it assesses illnesses commonly included in previous studies on this issue (e.g., colds and flu) and distinguishes between frequency and recency of these illnesses, which some researchers have suggested may be an important distinction (Jones, 2018). Each woman also completed a version of Wilson et al's (2005) Upper Respiratory Illness Scale, which assesses the frequency with which participants had suffered from ten symptoms of upper respiratory illness (e.g. sore throat, coughing) in the previous week (M=22.69, SD=6.91), and Duncan et al's (2009) Perceived Vulnerability to Disease scale (M=36.86, SD=13.66). Higher scores on each of these scales indicate poorer health. Eighteen women chose not to complete Stevenson et al's infection frequency subscale, 7 women chose not to complete Stevenson et al's infection recency subscale, and 8 women chose not to complete Wilson et al's Upper Respiratory Illness Scale.

Secretory Immunoglobulin A (SIgA)

Each woman provided a saliva sample via passive drool (Papacosta & Nassis, 2011) as part of a larger project on hormones and mating psychology (Jones et al., 2018a, 2018b, 2018c). Participants were instructed to avoid consuming alcohol and coffee in the 12 hours prior to participation and avoid eating, smoking, drinking, chewing gum, or brushing their teeth in the 60 minutes prior to participation. Saliva samples were frozen immediately and stored at -32°C until being shipped on dry ice to the Salimetrics Lab (Suffolk UK) for analysis where they were assayed using their Salivary Secretory IgA

Enzyme Immunoassay Kit 1-1602. Funding was available to analyze the first 221 women's saliva samples for SIgA. Following recommendations by Salimetrics Lab, we analyzed SIgA corrected for flow rate (M=70.09 µg/min SD=57.18 µg/min).

Results

Because not all variables were normally distributed we tested for significant correlations by calculating Spearman's rank correlation coefficients (using SPSS v21). Data are available at https://osf.io/f9tu2/. Table 1 shows the inter-relationships among all variables assessed in the study. There were no significant correlations between any aspects of facial appearance and any health measures (all absolute rhos<.123, all ps>.070). The one exception to this pattern of results was the positive correlation between attractiveness and scores on the Upper Respiratory Illness Scale (rho=-.083, p=.045). Note that this correlation is in the opposite direction to what would be predicted if attractiveness was a valid health cue and would not be significant if critical alpha was corrected for multiple comparisons. The same pattern of results as shown in Table 1 was also observed when Pearson's correlation coefficient was calculated instead of Spearman's rho and for partial correlations controlling for women's own age.

Discussion

We tested for putative correlations between women's facial attractiveness and responses on health questionnaires and salivary SIgA (a marker of immune function). Analyses revealed no significant relationships between facial

attractiveness and any health measures. These null results are inconsistent with studies in which reported health (Hume & Montgomerie, 2001; Gray & Boothroyd, 2012; Little et al., 2011b; Shackelford & Larsen, 1999) or objective health measures (Rantala et al., 2010) were reported as correlated with women's facial attractiveness. They are consistent with research reporting no significant correlations between facial attractiveness and either reported health (Kalick et al., 1998; Thornhill & Gangestad, 2006) or objective health measures (Foo et al., 2017; Gonzalez-Santoyo et al., 2015; Han et al., 2016).

We also observed no significant correlations between any of our health measures and either of two different objective measures of face-shape sexual dimorphism (vector and discriminant scores) or an objective measure of face-shape averageness. Thus, we do not replicate Thornhill and Gangestad's (2006) finding that women with more feminine face shapes reported fewer health problems or Jones' (2018) finding that women with more average face shapes reported better health. We also found no compelling evidence that facial coloration is a valid health cue. Although we observed a significant correlation between distinctiveness scores and scores on Wilson et al's Upper Respiratory Illness Scale, this correlation would not be significant when corrected for multiple comparisons and was in the opposite direction to what would be predicted if averageness was a valid health cue. We also found no compelling evidence that facial coloration functioned as a health cue, consistent with recent work showing cultural differences in facial coloration preferences (Han et al., 2018).

In our sample, more attractive faces tended to have more feminine and less distinctive face shapes and darker, yellower, but less red, skin. The lack of correlations between these facial characteristics and any of our health measures suggests attraction to these facial characteristics is not due to them functioning as cues of women's susceptibility to infectious illnesses. Although the relationships we observed between measures of face shape and attractiveness may appear weak compared to the striking effects these characteristics have when experimentally manipulated (see, e.g., Perrett et al., 1998), they are similar to those reported in other studies in which sexual dimorphism and averageness of face shape were measured from female face images (e.g., Kimori et al., 2009; Lee et al., 2014, 2016; Scott et al., 2010; Thornhill & Gangestad, 2006).

The various health measures considered in our study were only weakly inter-correlated. This underlines the importance of considering multiple health measures in studies of the possible links between health and attractiveness. A potential limitation of our study is that we investigated this issue in a university sample who are, presumably, relatively healthy and not exposed to a harsh environment. While we do not rule out the possibility that other types of sample may yet show stronger, more robust associations between health measures and facial appearance, we note here that the majority of previous studies investigating this issue also tested university samples.

In conclusion, our analyses show no evidence for correlations between women's health (estimated from various measures of their susceptibility to infectious illnesses) and their facial attractiveness, femininity, averageness, or skin color. Thus, our results do not support the popular and influential hypotheses that these characteristics are valid cues of infectious illnesses in young adult women (Grammer et al., 2003; Little et al., 2011a; Thornhill & Gangestad, 1999). Future studies focusing on potential links between attractiveness and other health factors, such as markers of youth and/or reproductive potential (Bovet et al., 2018), childhood health, or other aspects of health not included in this study, including more serious health conditions, may clarify the reasons for general consensus in judgments of women's facial attractiveness.

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Table 1. Inter-relationships among all variables assessed in our study. Table shows Spearman's rho.

	Masculinity (discriminant method)	Masculinity (vector method)	Distinctiveness	Yellowness	Redness	Lightness	Infection frequency scale (N=572)	Infection recency scale (N=583)	Upper respiratory illness scale (N=582)	Perceived vulnerability to disease scale (N=590)	SIgA (N=221)
Attractiveness	-.222**	-0.069	-.225**	.305**	-.099*	-.149**	-0.014	-0.05	0.079	0.003	-0.051
Masculinity (discriminant)		.571**	0.06	-.154**	.107**	0.018	-0.058	-0.054	-0.055	-0.058	0.056
Masculinity (vector)			0.038	-.170**	.108**	0.067	-0.01	-0.042	-0.001	-0.031	0.122
Distinctiveness				0.031	-0.033	-0.006	-0.034	-0.058	-.083*	0.027	-0.048
Yellowness					-.276**	-.415**	-0.02	0.04	-0.02	-0.047	-0.067
Redness						-.441**	-0.036	-0.022	-0.014	-0.045	0.071
Lightness							0.049	-0.005	0.047	.087*	0.017
Infection frequency scale (N=572)								.735**	.237**	.205**	-0.034
Infection recency scale (N=583)									.284**	.129**	-0.004
Upper respiratory illness scale (N=582)										.237**	-0.018
Perceived vulnerability to disease scale (N=590)											-0.085

** 2-tailed p-value <0.01 (2-tailed)

* 2-tailed p-value <0.05 (2-tailed)