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PERCEIVED VULNERABILITY TO DISEASE IS POSITIVELY RELATED TO THE STRENGTH OF PREFERENCES FOR APPARENT HEALTH IN FACES

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Abstract: People who are particularly vulnerable to disease may reduce their likelihood of contracting illnesses during social interactions by having particularly strong aversions to individuals who appear ill. Consistent with this proposal, here we show that men and women who perceive themselves to be particularly vulnerable to disease have stronger preferences for apparent health in dynamic faces than individuals who perceive themselves to be relatively less vulnerable to disease. This relationship was independent of possible effects of general disgust sensitivity. Furthermore, perceived vulnerability to disease was not related to preferences for other facial cues that are attractive but do not necessarily signal an individual's current health (i.e. perceiver-directed smiles). Our findings complement previous studies implicating perceived vulnerability to disease in attitudes to out-group individuals and those with physical abnormalities by implicating perceived vulnerability to disease as a factor in face preferences. Collectively, our findings reveal a relatively domain-specific association between perceived vulnerability to disease and the strength of aversions to facial cues associated with illness. Additionally, they are further evidence that variation in attractiveness judgments is not arbitrary, but rather reflects potentially adaptive individual differences in face preferences.

Keywords: facial attractiveness, health, illness, disgust, vulnerability to disease, individual differences

INTRODUCTION

Previous studies have shown that people who perceive themselves to be particularly vulnerable to disease demonstrate more negative attitudes to out-group individuals than do people who perceive themselves to be relatively less vulnerable to disease

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(FAULKNER et al. 2004; NAVARRETE and FESSLER 2006). These findings have been interpreted as evidence for a disease avoidance account of xenophobia, whereby negativity to out-group individuals is thought to reflect a mechanism that reduces the risk of exposure to 'novel' pathogens to which members of the in-group have not yet developed immunity (FAULKNER et al. 2004; NAVARRETE and FESSLER 2006). Perceived vulnerability to disease is also positively related to negative attitudes to individuals with physical disabilities (including the extent to which physical disability is implicitly associated with contagious disease), suggesting disease avoidance also contributes to social prejudices towards individuals with morphological abnormalities (PARK et al. 2003).

While the findings outlined above implicate disease avoidance behaviours in the development of attitudes to out-group individuals and those with physical disabilities, disease avoidance behaviours may also play an important role in the development of face preferences. Cues associated with apparent health in faces signal current health condition (e.g. pallor signals illness, ROUJEAU 2001), a genetic profile associated with immunity to infectious diseases (ROBERTS et al. 2005a), and a hormonal profile associated with medical health and fertility (LAW SMITH et al. 2006). Such findings indicate that cues to current and underlying physical health are visible in faces. Although people generally demonstrate strong preferences for faces they perceive to be healthy (GRAMMER and THORNHILL 1994; HENDERSON and ANGLIN 2003; KALICK et al. 1998; RHODES et al. 2001), disease avoidance mechanisms appear to contribute to individual differences in the strength of preferences for such faces. For example, preferences for faces with high apparent health are stronger during the luteal phase of the menstrual cycle, when progesterone level is raised, than during the late follicular phase, when progesterone level is relatively low (JONES et al. 2005). As high progesterone levels are associated with pregnancy (GILBERT 2000), increased aversion to unhealthy faces when progesterone level is raised may be a mechanism that compensates for maternal immunosuppression and protects the developing foetus (JONES et al. 2005). Indeed, pregnant women demonstrate stronger aversions to facial cues associated with low apparent health than do women with natural menstrual cycles (JONES et al. 2005). These findings complement increased avoidance of possible sources of contagion in food preferences during pregnancy (FESSLER 2002; FLAXMAN and SHERMAN 2000; see also FESSLER et al. 2005).

Although previous studies have emphasised effects on women's health preferences that are caused by hormone-mediated changes in vulnerability to disease (e.g. JONES et al. 2005), variation in the strength of preferences for facial health among individuals more generally may also be associated with individual differences in perceived vulnerability to disease. To investigate this issue, we tested if responses on the same perceived vulnerability to disease scale that has previously been used to test disease avoidance accounts of xenophobia (FAULKNER et al. 2004; NAVARRETE and FESSLER 2006) and attitudes to physical disability (PARK et al. 2003) are positively related to the strength of preferences for faces with shape,

colour, and texture cues associated with high apparent health. Such a relationship would present converging evidence that individual differences in perceived vulnerability to disease contribute to individual differences in social attitudes.

In addition to testing for a positive relationship between perceived vulnerability to disease and health preferences, we also investigated the domain-specificity of this relationship. Because any relationship between perceived vulnerability to disease and health preference might reflect an effect of sensitivity to unpleasant stimuli of any kind, rather than possible sources of contagion, we tested if the relationship between perceived vulnerability to disease and health preferences was independent of individual differences in domain-general disgust sensitivity (assessed using HAIDT et al.'s disgust sensitivity scale, HAIDT et al. 1994). Furthermore, because facial cues signalling social interest (e.g. direct gaze) are generally considered more attractive than facial cues signalling disinterest (e.g. averted gaze, MASON et al. 2005), but do not necessarily signal current physical condition (i.e. whether or not an individual is currently ill), we also tested if responses on the perceived vulnerability to disease scale were related to the strength of preferences for perceiver-directed smiles relative to other-directed smiles. This latter comparison was undertaken in an effort to establish if individuals who score high on the perceived vulnerability to disease scale are particularly discriminating about attractive facial cues in general, or if links between perceived vulnerability to disease and face preferences primarily occur for cues signalling health. We tested three specific hypotheses:

Hypothesis 1. Individuals with high scores on the perceived vulnerability to disease scale will demonstrate stronger aversions to unhealthy faces than will individuals with relatively low scores.

Hypothesis 2. The relationship between perceived vulnerability to disease and strength of health preferences will be independent of domain-general disgust sensitivity.

Hypothesis 3. Perceived vulnerability to disease will predict strength of preferences for health but not strength of preferences for perceiver-directed smiles.

While hypothesis 1 tested for a relationship between perceived vulnerability to disease and health preferences, hypotheses 2 and 3 tested the domain-specificity of this relationship.

METHODS

Stimuli

First, video sequences were manufactured using computer graphic techniques (for technical details of the computer graphics methods used, see TIDDEMAN et al. 2001 and ROWLAND and PERRETT 1995). In these video sequences, a synthetic female face (a composite of 10 female face images) was initially depicted with a neutral expression and either oriented its gaze from an averted position to a direct position while smiling (simulating pro-social behaviour being directed towards the viewer) or oriented its gaze from a direct position to an averted position while smiling (simulating pro-social behaviour being directed away from the viewer). Video clips consisted of 15 frames playing at a rate of 15 frames per second. Each frame in these video clips was then transformed by +/–150% of the differences in shape, colour, and texture between healthy and unhealthy prototype faces (for details of prototype-based image transformation methods, see TIDDEMAN et al. 2001 and ROWLAND and PERRETT 1995). This method has been used to manufacture healthy and unhealthy face stimuli in other studies of individual differences in face preferences (e.g. JONES et al. 2005). Furthermore, this method for manipulating apparent health in faces ensures that healthy and unhealthy versions of face images differ equally from an average (or typical) configuration of facial cues (TIDDEMAN et al. 2001; JONES et al. 2005). The healthy and unhealthy prototypes that were used to manipulate the health appearance of the composite face in the video sequences were manufactured by averaging the shape, colour, and texture information (see TIDDEMAN et al. 2001 and ROWLAND and PERRETT 1995) from 15 female faces that were judged particularly healthy and 15 female faces judged particularly unhealthy from a sample of 60 Caucasian women (aged 17–23 years old). Twenty independent raters (aged 18–26 years old, 10 male, inter-rater agreement: Cronbach's alpha = 0.84) performed these ratings (the order in which images were rated was fully randomised). This process created 2 versions of each of the original video sequences, each version being identical in terms of cues associated with social engagement (e.g. smiling and gaze direction), but varying in apparent health (see *Figure 1*).

PROCEDURE

Participants (N = 290, mean age = 22.20, SD = 4.84; 156 females) viewed these full-colour video clips one video clip at a time and rated the attractiveness of the person depicted in each video clip using a 1 (low attractiveness) to 7 (high attractiveness) scale. Participants rated the attractiveness of each video clip twice, once where the direction of eye movement was left to right and once where each frame in the video clips had been mirror reversed so that the direction of eye movement was right to left. Filler trials (trials on which face images had not been manipulated

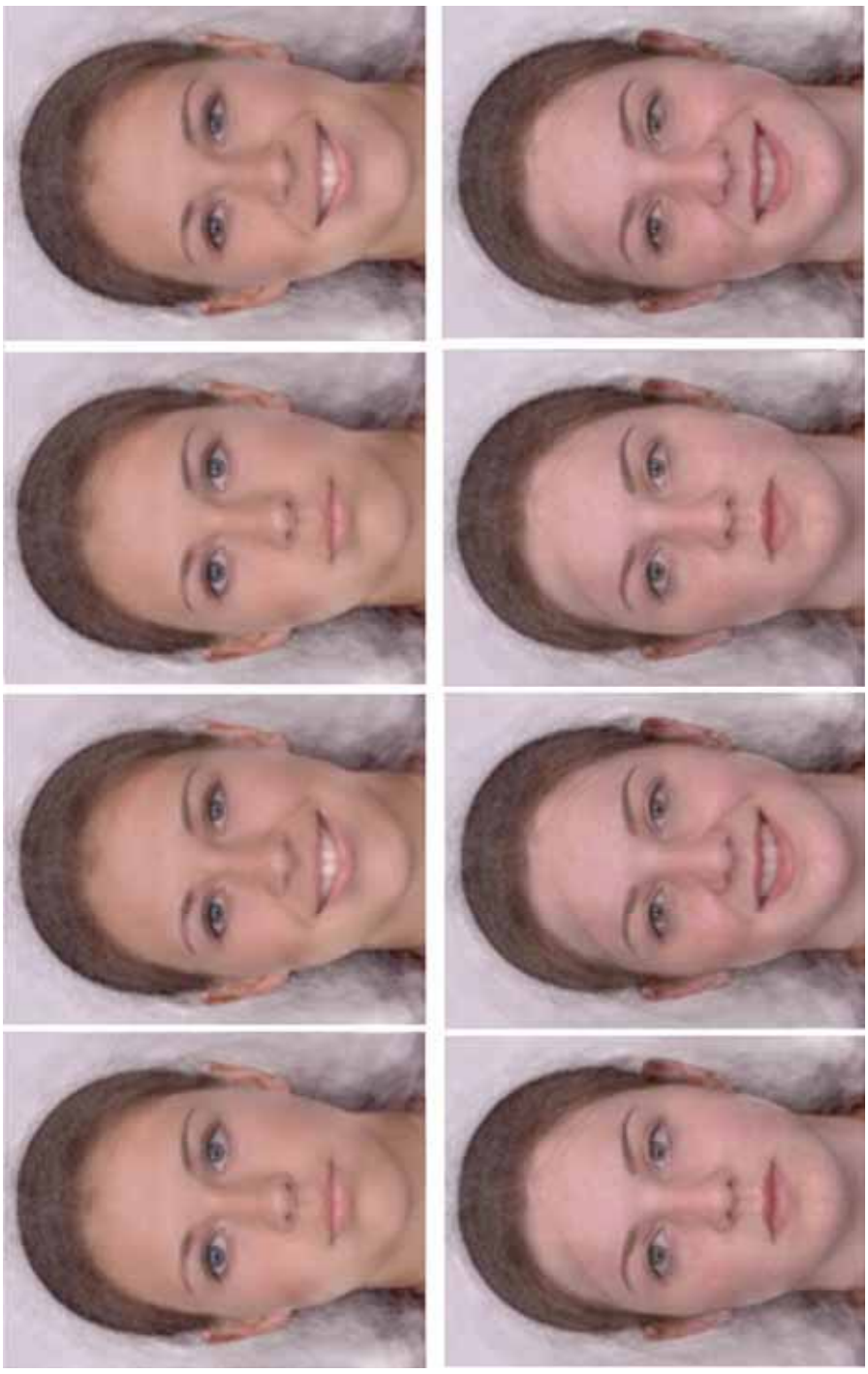

Figure 1. First (left image of each pair) and last (right image) frames from video clips used in the study. Sequences of images were manufactured using prototype-based transformations. In these sequences, a face image either smiled at the viewer (left column) or away from the viewer (right column). The face images in these sequences were also manipulated to appear particularly healthy (first row) or unhealthy (second row).

in apparent health or cues associated with social engagement) were interspersed throughout the test. The order in which participants viewed video sequences was fully randomised.

Participants also completed two questionnaires: the Perceived Vulnerability to Disease scale (PARK et al. 2003) and the Disgust Sensitivity scale (HAIDT et al. 1994). The Perceived Vulnerability to Disease scale assesses concerns about disease from rating-scale responses to statements, such as "If an illness is 'going around', I will get it". The Disgust Sensitivity scale assesses general sensitivity to potentially disgusting stimuli and situations from rating-scale responses to statements such as "Even if I was hungry, I would not drink a bowl of my favourite soup if it had been stirred by a used but thoroughly washed fly-swatter". High scores on these scales indicated high perceived vulnerability to disease and disgust sensitivity, respectively. The order in which participants completed the face-rating test and both questionnaires was fully randomised.

RESULTS

Responses were first analyzed using an ANCOVA [dependent variable: mean attractiveness rating; within subject factors: direction of smile (perceiver-directed, other-directed), health of face (unhealthy, healthy); between subject factor: sex of participant (male, female); covariates: perceived vulnerability to disease score, disgust sensitivity score].

The ANCOVA revealed a main effect of health of face ($F = 73.11$, $df = 1, 286$, $p < .001$), whereby faces with increased apparent health were preferred to those with lowered apparent health (Mean attractiveness rating of healthy faces = 5.12, $SE = 1.04$; Mean attractiveness rating of unhealthy faces = 3.81, $SE = 1.12$). As we predicted, however, this main effect of health of face was qualified by an interaction with perceived vulnerability to disease scores ($F = 4.33$, $df = 1, 286$, $p = .038$), whereby individuals with high perceived vulnerability to disease scores demonstrated stronger preferences for health than did individuals with relatively low perceived vulnerability to disease scores. Health of face did not interact with general disgust sensitivity ($F = 0.51$, $df = 1, 286$, $p = .476$).

The ANCOVA also revealed a main effect of direction of smile ($F = 10.71$, $df = 1, 286$, $p = .010$), whereby perceiver-directed smiles were rated more attractive than other-directed smiles (Mean attractiveness rating of perceiver-directed smiles = 4.56, $SE = 1.02$; Mean attractiveness rating of other-directed smiles = 4.37, $SE = 1.03$). This main effect of direction of smile was not qualified by an interaction with perceived vulnerability to disease scores ($F = 0.001$, $df = 1,286$, $p = .98$), although participants who scored high on the disgust sensitivity scale tended to show weaker preferences for perceiver-directed smiles than participants who scored low on the disgust sensitivity scale ($F = 3.40$, $df = 1, 286$, $p = .066$). The ANCOVA revealed no other significant effects or effects that approached significance (all $F < 1.648$, all $p > .20$).

Because perceived vulnerability to disease interacted with health preference but not preference for perceiver-directed smiles, we conducted a further ANCOVA to test for a significant difference between the strengths of these relationships [dependent variable: strength of preference; within subject factor: preference type (perceiver-directed smiles, health); between subject factor: sex of participant (male, female); covariate: perceived vulnerability to disease score]. This analysis revealed a main effect of preference type ($F = 37.75$, $df = 1, 287$, $p < .001$), which was qualified by an interaction between preference type and perceived vulnerability to disease score ($F = 4.00$, $df = 1, 287$, $p = .048$). This interaction between preference type and perceived vulnerability to disease score confirms that perceived vulnerability to disease is a significantly better predictor of the strength of health preferences than of the strength of preferences for perceiver-directed smiles, complementing the finding from our main analysis. The follow-up ANCOVA revealed no other significant effects (all $F < 1.80$, all $p > .18$).

DISCUSSION

Our findings support each of our 3 specific hypotheses. Consistent with our first hypothesis, individuals who perceived themselves to be particularly vulnerable to disease demonstrated stronger preferences for healthy faces than did individuals who perceived themselves to be less vulnerable to disease. Furthermore, this relationship between perceived vulnerability to disease and health preferences was independent of general disgust sensitivity, supporting our second hypothesis. Although we demonstrated that perceiver-directed smiles were generally considered more attractive than other-directed smiles, there was no effect of perceived vulnerability to disease on the strength of preferences for perceiver-directed smiles. Moreover, perceived vulnerability to disease was a significantly better predictor of preferences for healthy faces than preferences for perceiver-directed smiles. Both of these latter findings support our third hypothesis.

Collectively, the findings outlined above support the proposal that individual differences in preferences for apparent health in faces are associated with individual differences in vulnerability to disease (JONES et al. 2005) and reveal a relatively domain-specific relationship between perceived vulnerability to disease and health preferences. Thus, our findings implicate disease avoidance in face preferences and complement findings from previous studies that implicated disease avoidance in prejudices towards out-group individuals and individuals with morphological abnormalities (see PARK et al. 2003; NAVARRETE and FESSLER 2006). While we present evidence that perceived vulnerability to disease and health preferences may share some common underlying processes and mechanisms, further studies are needed to identify the proximate mechanisms through which individual differences in both health preferences and perceived vulnerability to disease develop.

Many researchers have suggested that beauty is in the eye of the beholder, implying that individual differences in face preferences are essentially arbitrary (e.g. HOGG and GRAHAM 1995). While it may be true that there is no universal agreement about what types of faces are attractive (HÖNEKOPP 2006), our findings for perceived vulnerability to disease and health preferences contribute to a growing literature demonstrating that individual differences in attractiveness judgments are not arbitrary, but reflect systematic variation in face preferences that are potentially adaptive. Previous studies have shown that face preferences vary as a function of women's physical condition (e.g. effects of menstrual cycle phase, oral contraceptive use, and pregnancy, JOHNSTON et al. 2001; JONES et al. 2005; PENTON-VOAK et al. 1999), that the strengths of preferences for masculinity in different modalities are related (e.g. concordant preferences for masculine faces and putative male pheromones, CORNWELL et al. 2004), and that physical and genetic similarity affect preferences (DEBRUINE 2004; ROBERTS et al. 2005b). Complementing these demonstrations of systematic variations in face preferences, here we show that perceived vulnerability to disease predicts the strength of men and women's preferences for facial cues associated with illness, potentially reducing the likelihood of individuals who are particularly vulnerable to disease contracting illnesses during social interactions.

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