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National income inequality predicts women's preferences for masculinized faces better than health does

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In their paper 'The health of a nation predicts their mate preferences', DeBruine *et al.* [1] find that women's preferences for facial masculinity from a large, cross-cultural sample of individuals from developed countries is negatively correlated with a composite National Health Index (NHI). They interpret this finding in the context of published observations that men with masculine facial characteristics have better health [2,3] and the prediction that such men will sire healthier than average offspring [3].

This prediction is derived from the hypothesis that exaggerated sex-typical traits (here, facial masculinity) are a cue of developmental health (with masculinity often conceptualized as an honest signal owing to testosterone-mediated immunosuppression). These traits may also signal potentially 'negative' behavioural traits such as aggression and low parental investment (e.g. [4]). Masculinity preferences may therefore represent a facultative trade-off between preferences for investment and cues to heritable (i.e. genetic) health, and should be stronger in environments where health, in general, is poorer (e.g. [5]).

An alternative to the immunocompetence/investment trade-off perspective is the hypothesis that variation in preferences is explicable primarily (or exclusively) in terms of intrasexual competition. As well as aggression and low investment, facial masculinity may signal dominance [6], which, in certain environments, predicts competitive success in male hierarchies [7]. Women might therefore be more attracted to masculinity in environments in which the benefits of dominance are increased and/or the costs of aggression decreased. DeBruine *et al.* [1] acknowledge this possibility, and because they published their data as supplementary material, we were able to explore it further.

Income inequality is an important determinant/predictor of population health, women's empowerment, violent crime, risky behaviours, accidental death and education [8]. Many of these factors might influence the benefits a woman gains by having a highly masculine partner, both because of the benefits of having a healthy and wealthy partner are greatest in unequal societies, and because inequality in a society drives male–male competition. Research by Daly & Wilson [9] highlights the importance of intrasexual selection on males as a factor determining rates of violence and homicide by men—both against women and against other men. They have shown that the Gini index of income inequality is one of the most important predictors of differences in homicide rates among American states and Canadian provinces [10], presumably because greater inequalities of wealth distribution are associated with stronger intrasexual competition among men.

We wished to test the prediction that women would prefer masculinized faces most strongly not only in societies where health is poor, but in societies where income is distributed unequally, homicide rates are high and women are less empowered and educated. Accordingly, we combined DeBruine *et al.*'s [1] data on national preference for facial masculinity (NPFM) and NHI, with data on income inequality, national homicide rates, women's empowerment and education that we gathered from publicly available online sources (see the electronic supplementary material). We first estimated the pairwise correlation of each measure with preference for facial masculinity and then explored all factors in multiple regressions. Several measures were significantly correlated with national preferences for masculinized faces, the most prominent of which were Gini coefficient, a commonly used statistical index of disparity in household income ($r = 0.84$, $p < 0.0001$), homicide rate ($r = 0.66$, $p < 0.0005$), total fertility rate ($r = 0.63$, $p < 0.0005$) and NHI ($r = -0.51$, $p < 0.005$; see electronic supplementary material, table S1 for all correlations).

These variables were entered as independent variables into a linear regression with NPFM as a dependent. The best model (fitted to weighted data by forward stepwise regression or using Mallows' C_p) included only an intercept and the Gini index ($R^2_{adj} = 0.69$, $F_{1,28} = 66.7$, $p < 0.0001$; Gini std $\beta = 0.839$) and no other terms. Countries with more equality in income had weaker preferences for masculinized faces. This model compared favourably with the model that included only NHI ($R^2_{adj} = 0.24$, $F_{1,28} = 0.96$, $p = 0.004$; NHI std $\beta = -0.512$), and the effect of NHI became positive and non-significant once Gini was added to the model reported by DeBruine *et al.* (NHI std $\beta = 0.066$, $t_{27} = 0.48$, $p = 0.63$). It is unlikely that the loss of NHI as a significant predictor of NPFM is due to serious multi-collinearity (VIF for both fitted independent variables = 1.75).

To assess whether shared variance between the predictor variables was accounting for these findings, two weighted hierarchical regression models (with either Gini or NHI entered in block 1) were constructed to

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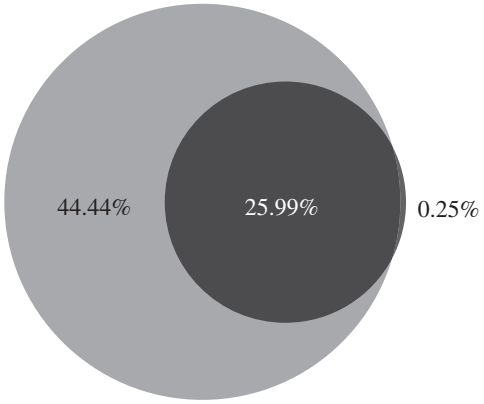

Figure 1. Proportion of variance in masculinity preferences which is predicted by: variation in Gini coefficient alone (left); shared variation in Gini Coefficient and National Health (centre), and additional variation (non-significant) uniquely explained by National Health Index (right). Light grey colour, Gini coefficient; black colour, National Health Index.

determine the shared and the unique contribution of each to the variance explained by the model. Figure 1 illustrates that the overwhelming part of the variance in NHI that predicts NPFM is subsumed by Gini.

Our analysis suggests that income inequality is a better predictor of national variation in preferences for masculinized male faces than NHI. The same general caveats, however, apply to income inequality as do to NHI or any other correlate. National health and income inequality are strongly correlated and are probably functionally related [8]. Thus, the relationship between Gini and preference for masculinized faces might be mediated at least in part by poor health (low NHI) in countries with large inequalities in income (high Gini). It is also possible, however, that other correlates of Gini such as male investment behaviour might mediate the effect of Gini.

Homicide rate, one direct index of male–male competition (most murders involve both male protagonists and victims [9]), is strongly correlated with NPFM. To explore the relative power of male–male competition and national health status to predict preferences, we included just Homicide rate and NHI as independent variables in a multiple regression (omitting Gini). If both health and male–male competition are important then both variables should be significant predictors, but the model retained only homicide ($R^2_{adj} = 0.65$, $F_{1,28} = 54.3$, $p < 0.0001$; homicide rate (ln) std $\beta = 0.812$), with NHI non-significant when homicide rate was considered (std β ln $= 0.11$, $t = 0.68$, $p = 0.50$: all VIF < 1.95). On the evidence presented here, it is more probable that the relationship between income inequality and preferences is mediated by competitive male encounters alone than by national health or both.

Like NHI, however, it is outcompeted by Gini as a predictor of NPFM. Adding Gini to a multiple regression containing Homicide rate renders Homicide rate non-significant (std β ln $= 0.31$, $t = 1.38$, $p = 0.18$). This may be because homicide rate encompasses a very small proportion of the male–male competitive encounters that arise as a result of inequality, or because the effects of income inequality are more complex than either health or homicide can capture.

DeBruine and co-workers have provided important data that have exposed interesting patterns of worldwide variation in preferences. They suggested one possible route by which this variation arises: that mating with highly masculinized males may deliver a benefit in countries with health challenges. We show that income inequality, an important determinant of both national health status and male–male competition and violence is a better predictor of national preferences for masculine faces, and that, in comparison to national health status, homicide rate predicts more variation in masculinity preferences. These findings do not preclude the possibility that some of the observed pattern of findings may come about through the effects of income inequality on national health, but they are more consistent with an intrasexual-competition hypothesis, in which women prefer cues associated with dominant men in environments where male–male competitive aggression has more positive effects on male wealth and status. We hope our suggestions will lead to direct testing of the factors that shape mating preferences.

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