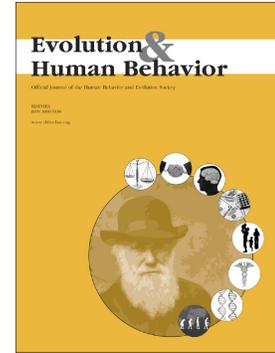


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Aggressor or protector? Experiences and perceptions of violence predict preferences for masculinity.

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Abstract

Women's preferences for masculine male partners have been explained in terms of heritable health. The evidence between masculinity and health, however, is controversial and therefore, alternative explanations for masculinity preferences reflecting income inequality and protection from violence have been proposed. This study thus aimed to test the effect of exposure to violence (i.e., experiences of robberies and perceptions of danger) on the individual masculinity preferences of women and men from the capital city of Colombia, Bogota, and surrounding small towns. One hundred and fifty three adult participants (mean age \pm S.D.= 31.3 \pm 9.4), all heterosexual, were surveyed in reference to indicators related to health (e.g., drinking water access, frequency of illnesses), access to media (e.g., television and internet access), education (e.g., graduating from high school, attending university) and exposure to violence (e.g., frequency of robberies/attacks, feelings of danger from violence). Participants made two alternative, preference forced-choice for masculinized and feminized versions of both rural Salvadoran and European male faces. We found that men and women exposed to higher levels of violence preferred less masculine male faces, although this effect was only significant for women. Additionally, the effect of violence exposure was more relevant for the Salvadoran stimuli. Violence contributed significantly to explaining masculinity preferences after controlling for participant age, education, access to media, and health-related factors. These preferences may reflect women's strategy to avoid male violence demonstrating that exposure to violence matters in interpersonal attraction.

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Key words: masculinity, violence, education, development, health, interpersonal attraction, competition, intra-sexual selection

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1. Introduction

Sexually dimorphic bodily traits are presumed to have arisen from sexual selection favouring those phenotypic and genotypic characteristics that increase mating opportunities and offspring (Puts et al., 2012). Sexual selection in males could have operated through female mate choice (Little, DeBruine, & Jones 2011a; Little, DeBruine, & Jones, 2011b) and/or through male-male competition (Puts, 2009; Little, Jones, & DeBruine, 2013; Barber, 1995). A great deal of attention however has been put into studies of women's masculinity preferences reflecting mate choice at the individual and population level (Rhodes et al., 2003; Thornhill & Gangestad, 2006; Rantala et al., 2013; DeBruine et al., 2011; Batres & Perrett, 2016), while less emphasis has been given to the effects of male-male competition at any level of study (de Barra et al., 2013; Batres & Perrett, 2014, Snyder et al., 2011). Studies at the population level have utilized measures of health (e.g., mortality), violence (e.g., homicide rate), and education (e.g., high-school attendance rates), which are aggregated indicators that summarize the state of a population as a whole. This level of measurement is usually based on environmental factors that are external to the individual, but that give a contextual framework for studies. At the individual level, measures considered are those that vary within a population and are experienced differently by each individual.

In support of mate choice being the selective pressure behind women's masculinity preferences, several studies have found a positive correlation between masculinity and different indicators of male mate value (i.e., traits associated with heritable health or those important for the acquisition of resources; Little, DeBruine, & Jones, 2011a; Little, DeBruine & Jones, 2011b). At the individual level, measures of actual health (i.e., childhood frequency of diarrhoea, health history, frequency and duration of respiratory diseases) correlated positively with masculinity preferences for male faces (de Barra et al., 2013) and with measures of facial masculinity (Rhodes et al., 2003; Thornhill & Gangestad, 2006). Positive correlations between health indicators and attractiveness to masculinity are not the rule though. Lie, Rhodes & Simmons (2008) found that genetic aspects of health (i.e., diversity of the major histocompatibility complex genes of their participants) did not predict their facial masculinity. Fink and colleagues (2007), on the other hand, found that men's strength positively correlated with facial ratings of dominance, masculinity, and attractiveness. These findings were explained in terms of strength being an honest signal of capacity to acquire resources and higher social status. Adding to Fink's results, Snyder et al., (2011) found that the more vulnerable women felt to crime, the more they preferred partner

characteristics of aggressive-formidable men. These results suggest that formidable, masculine men may be effective protectors for women when they feel at risk.

At the population level, contexts that have been suggested to affect women's reproductive decisions include measures of environmental health (e.g., parasite load as potential virulence and number of parasites in the environment), development (e.g., measured as the frequency of internet use), income inequality (e.g., Gini coefficient), and access to education (e.g., DeBruine et al., 2010a, b; Batres & Perrett, 2014; Brooks et al., 2011; Kasser & Sharma, 1999). Evidence at this level, supporting female mate choice as the driver for masculinity preferences is found by DeBruine et al., (2010a, b). Here women living in USA states and countries with a higher health index had lower preferences for masculine male faces than women living in places with a lower health index. Similarly, Penton-Voak, Jacobson, and Trivers (2004) attributed their findings of rural Jamaican women preferring more masculine looking males than British women, to the Jamaican environment having a greater pathogen load which could make signs of heritable health more important for women. Additionally, Kasser & Sharma (1999) show that when women have less access to education, they prefer characteristics associated with resource-acquisition in potential partners. Conversely, Scott et al., (2014) found that facial masculinity preferences for both men and women increased with lower levels of disease burden across 12 populations and that these preferences were predicted by level of urbanization, rather than presumed pathogen risk. Likewise, Snyder et al., (2011) found that women's mate preferences were not predicted by population violence (i.e., neighbourhood crime).

Inconsistencies in the results of studies considering mate choice as the driving force behind women's masculinity preferences (both at the population and individual level) may be due to an underestimation of the role of intra-sexual competition in men (Puts, 2009). Such inconsistencies could also be due to the disregard of the link between masculinity and behavioural traits undesirable to women. For example, more masculine men are more aggressive and are perceived as less trustworthy (Fink & Penton-Voak, 2002; Gangestad & Simpson, 2000; Jones et al., 2005; Little et al., 2008).

Women's masculinity preferences at the population and individual level have been found to be consistently influenced by male-male competition when taking into account risks associated to public violence (e.g., violence coming from strangers). At both levels of analysis, violence elicited higher masculinity preferences in women. Brooks et al., (2011)

found that a country's income inequality index, an indicator of the level of violence, predicted masculinity preferences better than a country's health index. Since male masculinity is associated with dominance (Dijkstra & Buunk, 2001; Batres, Re, & Perrett, 2015), it could be advantageous for women to choose a more masculine male in environments with a high level of male-male competition (Puts, 2010; Brooks et al., 2011). Ryder et al., (2016) found that at the individual level, women preferred more physically formidable and dominant partners when they felt more at risk of crime in public places. Complementing this finding, Little et al., (2011b) found that after priming women with images of male-male fights, they preferred more masculine male faces. The literature described above suggests masculine men may be better equipped with physical traits for antagonistic encounters with other men. This in turn could allow more masculine men to have higher statuses and hence be more attractive to women. Nevertheless, when women prefer a more masculine man, they may also put themselves at risk of increased antagonistic behaviours in the context of a romantic relationship. In fact, Li et al., (2014) found that when women were primed with images of male-on-female aggression, women's masculinity preferences were disrupted and their feelings of disgust and anger increased. These findings may hint at different effects of domestic violence and/or violence outside the home on masculinity preferences.

Undesirable correlates to masculinity include preference for short-term, rather than long-term relationships, low trustworthiness and emotionality (Boothroyd et al., 2008; Rhodes et al., 2005; Boothroyd et al., 2007; Perrett et al., 1998). Additionally, Suguhara and Warner (2002) found that men's dominance, decision-making power, and possessiveness (all linked to masculinity) were associated with violent behaviours, including psychological aggression, physical assault, and injury in intimate relationships. Therefore, having a higher preference for more masculine, dominant, stronger men may be beneficial under certain circumstances and detrimental in others. Preferring a more masculine partner may be beneficial in environments where the source of violence is external and protection by a strong partner is an advantage. However, when the source of violence lies within the household or partnership, preferences may switch to less masculine partners (Li et al., 2014), who will be less aggressive and dangerous to women, particularly for those women who perceive themselves as vulnerable.

While the literature presented above suggests that women's masculinity preferences differ depending on context and individual perceptions, there is also evidence that men's judgments of male facial masculinity parallel women's judgments (Burris & Little, 2006; Gangestad et al., 2002; Haselton & Gangestad, 2006). For example, one study found that men were more jealous of masculine men (Dijkstra & Buunk, 2001). This finding suggests that men are aware of more masculine men being better able to secure short-term relationships than less masculine peers. Complementing this finding, Watkins et al., (2011) reported that men who have more feminine looking partners, perceived more masculine male faces as more dominant than men with masculine looking partners.

Intra-sexual competition would favour characteristics that enable exclusion of other mate-rivals by force or threat (Puts, 2009; Little, Jones, & DeBruine, 2013; Barber, 1995) or assist in the monopolization of resources that interest females (Puts, 2010; Little, DeBruine, & Jones, 2011b). As men engage in fighting more than women do, it would be advantageous for men to possess the necessary skills to recognize the fighting ability of potential rivals and hence reduce the costs of a future antagonistic interaction and perhaps the risk of losing a romantic partner. Borraz-Leon et al., (2014) found that men with low facial symmetry (linked to lower masculinity) rated symmetrical men as more attractive to women and as more likely to be potential rivals than less symmetrical men. This suggests that men with low facial symmetry may be at higher risks of cuckoldry than symmetric men, and hence they would have to be more sensitive to cues of male quality.

In the current study, we examined the relationship between masculinity preferences for male faces and perceptions of danger from violence in both men and women. Previous research has demonstrated that facial and vocal masculinity and dominance are associated with greater strength and formidability (Fink, Neave, & Seydel, 2007; Wolff & Puts, 2010) and therefore, we predicted that masculinity preferences would be higher in environments where violent scenarios are more common and protection is needed. More specifically, individuals who experience frequent violence and perceive a greater level of threat from violence should display higher masculinity preferences. Women's preferences may reflect mate choice while men's preferences could reflect either awareness of what women prefer or a personal desire for alliances with more physically dominant same-sex peers from whom one could get protection. Indeed, in several contexts, men's and women's preferences for others' characteristics are congruent (Perrett et al., 1998; Scott et al., 2014; Swami & Tovee, 2005; Batres & Perrett, 2014).

Examining individuals' experiences and perceptions of violence may help understand variation in women's and men's masculinity preferences (DeBruine et al., 2010a, 2011; Brooks et al., 2011) and may contribute to the debate between female mate-choice and male-male competition as drivers of masculinity preferences in women. As health, media access (internet access, degree of urbanization) and education have all been previously linked to masculinity preferences, their contribution to explaining masculinity preferences was also evaluated.

Colombia as study site

Data collection took place in Colombia, one of the most violent nations in the world, with economic, developmental, and health indicators that differ substantially from frequently studied populations (e.g., UK and USA). Colombia's homicide rate per 100,000 inhabitants is 30.8 compared to 1.0 that of the UK. Additionally, life expectancy for women in Colombia is 7% shorter than in the UK. Understanding the effect of violence on masculinity preferences has been previously attempted at the population level within developed populations with low indicators of violence or by priming people with images related to violence. Therefore, using Colombia as a study site maximizes the chance of finding effects of violence. Furthermore, sampling urban and rural areas within Colombia, where violence indicators differ, increases the power of our study design.

Masculinity preference studies have been mostly done with participants who are university students in industrialized countries (e.g., United Kingdom, United States of America, Japan, etc) and/or via online experiments targeted at participants that have high access to development (Boothroyd et al., 2007; DeBruine et al., 2010; Penton-Voak, Jacobson, & Trivers, 2004). By contrast, the current sample is more representative, ranging from educated individuals living in an urban setting to individuals with less access to media, education, and development living in rural settings. Moreover, Batres & Perrett (2014) found that online samples are not representative of populations in developing countries (like Colombia) and therefore the current sample was recruited through in-person testing.

2. Methods

Research protocols were approved by the Ethics Committee of the University of St Andrews. Written informed consent was obtained from all participants in the study. All data were collected and stored in compliance with the UK's Data Protection Act.

2.1 Participants

Colombians living in either Bogota or in small towns (population <10,000) located at least two hours away from Bogota were selected as the study population. Participants recruited outside of Bogota were mostly from the states of Magdalena (61%) and Cundinamarca (25%), with the remainder (14%) being from the states of Bolivar, Meta, or Tolima.

Since violence can affect men and women of any age, our adult participants were recruited regardless of their age. It must be noted, however, that the results presented here are the same if we were to have limited our sample to a reproductively aged population (i.e., 18 to 46 years of age). One hundred and sixty one participants (81 women and 80 men) were recruited (81 lived in Bogota and 80 lived in small towns). All participants were older than 17 and eight outliers were omitted in order to achieve normalization of age for the statistical analyses (i.e., participants older than 68 years of age). This left a sample of 153 participants, of which 76 were men (mean age \pm S.D.= 31.2 \pm 9.6) and 77 were women (mean age \pm S.D.= 31.5 \pm 9.4).

2.2 Stimuli used

Stimuli were constructed from two sets of face images. The first set of pictures was Caucasian (European descent), with 40 females (mean age \pm S.D.= 23.04 \pm 3.81) and 40 males (mean age \pm S.D.= 25.25 \pm 4.64). This set of pictures was accessed from an open source library (3D.SK). The second set was selected from photographs of individuals from a rural area of El Salvador (Hispanic descent), with 40 females (mean age \pm S.D.=25.43 \pm 4.64) and 40 males (mean age \pm S.D.=26.32 \pm 5.32) (see Batres & Perrett, 2014 for details). This second set of faces was included since our participants are also from a Latin American country and of Hispanic descent. All face images were taken under constant camera and lighting conditions and showing a neutral expression. Each image was aligned to a standard inter-pupillary distance and 189 points were delineated. Five male and five female composite images were made for each ethnic group (Salvadoran and European) by averaging three original face images. Additionally male and female prototypes were produced by averaging all female and all male faces separately. Masculinity transforms were made by adding (or subtracting) 50% of shape difference between male and female prototypes to each of the composites (Tiddeman, Burt, & Perrett, 2001). Texture and colour were held constant

(See Figure 1). This resulted in 10 pairs of facial stimuli (5 European male pairs, 5 Salvadoran male pairs).



Figure 1: Example pairs of European (left) and Salvadoran (right) male facial stimuli. The left of each pair is feminized and the right is masculinized in shape.

Image pairs were presented on printed laminated sheets to each participant. Each sheet showed one pair of faces, 10 with masculinized faces on the right. Sheet order was randomized across participants. Preferences for male faces alone are presented here. Participants were asked which face (the right or the left) they considered more attractive (Spanish translation: *Cuál de las dos caras le parece mas atractiva?*) to assess their masculinity preferences. When participants were doubtful about the meaning of the question, the interviewer clarified that they should choose the face they considered most handsome (Spanish translation: *Cuál de las dos caras le parece mas guapa?*). Subsequently, participants answered a 57 question survey (see the Appendix for the questions analysed here). The initial questions inquired about relationship status and whether participants had any children. The survey also included questions related to indicators of education, access to media (internet frequency use and having a TV at home), health, danger/violence experiences, and other relevant questions to this study. Several questions were asked for each indicator. For education, high school attendance, high school graduation, and university attendance were assessed. All education questions were binary (yes/no). To establish participants' access to media, they were asked if they had a television at home and how frequently they used the internet. In reference to health, participants were asked if they had access to hospitals, drinking water (both of which were binary), how frequently they were ill during their childhood, and how many times on average they had been ill over the past year, among other questions. Violence questions inquired about both perceptions of danger from violence in the country, city/town, home, experiences of robberies/attacks in the past year, and how much participants agreed with men being dangerous to their children.

3. Variables analysed

3.1 Dependent variable

Participants' masculinity preferences were calculated as the percentage of faces high on the trait that were selected as more attractive across the pairs.

3.2 Independent variables

3.2.1 Factor analysis

When possible, factors were extracted from the violence, education, development, and health questions via principal component analysis (see Table 1 and Figure 2). The factorability of the questions related to each indicator was evaluated via the Kaiser-Meyer-Olkin measure of adequacy (when greater or equal to 0.6, it was accepted) and Bartlett's test of sphericity (accepted when $p \leq 0.05$). All solutions were un-rotated and based on Eigen values greater than 1. All loadings are shown in Table 1. Scores were saved as new variables/factors.

Indicators	Factors and loadings		
	<i>Violence</i>	<i>Danger feelings</i>	<i>Men danger to children</i>
Home danger		0.49	-0.20
City/town danger		0.83	0.10
Country danger		0.75	0.38
Robbed frequency		0.56	-0.42
Men danger to children		-0.03	0.86
	<i>Health</i>	<i>Health access</i>	<i>Illnesses</i>
Drinking water		0.63	-0.10
Born in a hospital		0.70	-0.17
Access to a hospital		0.77	-0.12
Average illnesses		0.26	0.75
Childhood illnesses		0.08	0.80
	<i>Education</i>	<i>Education</i>	
Graduated high-school		0.70	
Attended high-school		0.89	
Attended university		0.83	

Table 1: Factor loadings: Factors extracted for each indicator and their respective loadings (bold >0.45).

One factor was extracted from the three questions asked about education. This education factor explained 65% of the variance of the questions. Two factors were extracted from the five questions related to health. The first factor, health access, strongly related to drinking water access, being born in a hospital, and having access to a hospital. The second illness factor was heavily loaded on average illnesses in the past year and frequency of childhood illnesses. These two factors explained 29% and 25%, respectively, of the total variance described by the five health-related questions. For the five questions asked in reference to violence experienced or perceived, two factors were extracted. The first factor, danger feelings and robberies, explained 35% of the variance from the violence questions and the second factor, mostly loaded with men being dangerous to their children, explained 22% of the variance from the violence questions. Since 100% of participants reported access to television and electricity, only the internet access frequency question was used as a measure of access to media.

4. Results

4.1 Masculinity preference

A repeated-measures ANOVA was conducted with masculinity preferences for male faces as the dependent variable, face ethnicity (European vs Salvadoran) as a within-subjects factor, and participant sex as a between-subjects factor. Covariates in this model were participant age, individual illness factor, health access factor, media access (i.e., internet access frequency), danger feelings/robberies factor, and the men dangerous to children factor. Residuals from this analysis (residual masculinity preferences for Salvadoran faces and European faces) were normally distributed (skewness and kurtosis lower than +/- 0.74).

This test revealed that face stimulus ethnicity interacted with participant's sex $F(1,141)= 4.68, p=0.034, \eta^2= 0.031$). Women showed higher masculinity preferences for Salvadoran male faces than men. Masculinity preferences for European male faces were very similar for both men and women (see Figure 2). Additionally, ethnicity of the stimuli used interacted significantly with the danger feelings/robberies factor $F(1,141)=4.43, p=0.038, \eta^2= 0.030$). Face stimulus ethnicity did not interact with any other variable (namely sex, age, access to media, and factors relating to health access, individual illnesses, education, or men being dangerous to children; all $p>0.32$).

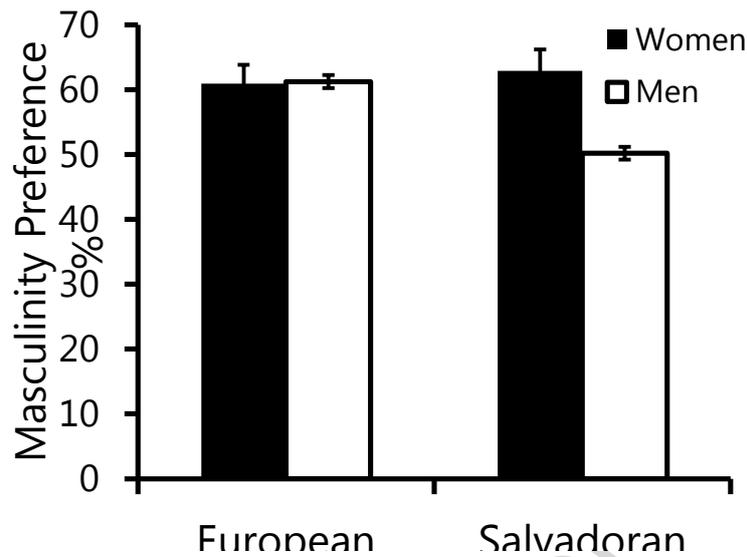


Figure 2: Stimulus face ethnicity effect depending on participants' sex.

As stimulus ethnicity significantly interacted with participants' sex and with the danger feelings/robberies factor, subsequent analyses were done separately for women and men via univariate ANOVAs for each face ethnicity. Additionally, previous studies have shown that own-ethnicity faces are a better predictor for attractiveness judgements (Stephen et al, 2012), hence performing separate analyses for each ethnicity makes theoretical sense.

4.2 Women's masculinity preference

4.2.1 Masculinity preferences for European faces

Women's average masculinity preferences for European male faces were significantly affected by the men being dangerous to their children factor ($F(1,83)=4.77$, $p=0.032$, $\eta^2=0.058$). The more women agreed with the statement "Men are dangerous to their children", the lower their masculinity preference. To graphically represent these results, the repeated measures ANOVA was re-run excluding the men being dangerous to their children factor, the unstandardized residuals were saved and then plotted against the men being dangerous to their children factor (Figure 3).

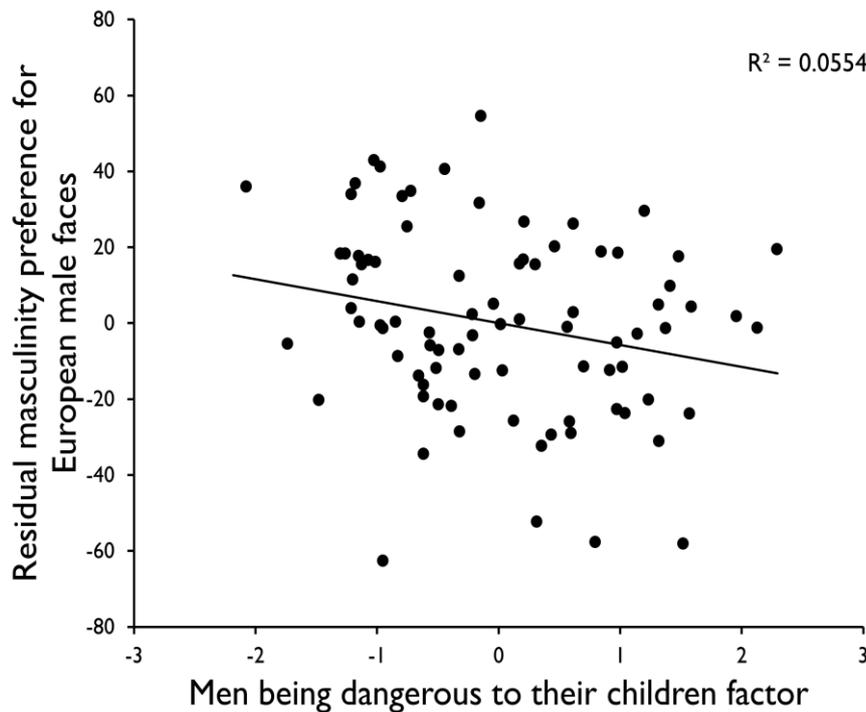


Figure 3: The effect of men being dangerous to their children factor on women's masculinity preferences for European male faces (% trials choosing masculine faces).

None of the factors relating to health, health access and individual illness, education, access to media (i.e., internet access frequency), or danger feelings/robberies factor had a significant effect on masculinity preferences and hardly contributed to variation in male masculinity preferences (health access: $F(1,83)=0.134$, $p=0.71$, $\eta^2=0.02$; individual illness: $F(1,83)=0.932$, $p=0.34$, $\eta^2<0.012$; education: $F(1,83)=0.025$, $p=0.87$, $\eta^2=0.000$; access to media: $F(1,83)=0.012$, $p=0.91$, $\eta^2<0.000$; danger feelings/robberies: $F(1,83)=2.18$, $p=0.14$, $\eta^2=0.027$). The variable that contributed most to explaining masculinity preferences was the men being dangerous to their children factor ($\eta^2=0.058$).

4.2.2 Masculinity preferences for Salvadoran faces

Women's average masculinity preferences for Salvadoran male faces were significantly affected by both of the violence factors, men being dangerous to their children factor ($F(1,83)=5.26$, $p=0.025$, $\eta^2=0.064$) and danger feelings/robberies factor ($F(1,83)=4.84$, $p=0.031$, $\eta^2=0.059$). In reference to the men being dangerous to their children factor, the more in agreement women were with this statement, the lower their masculinity preference. Likewise, when the danger feelings/robberies factor was higher, women's masculinity preferences were lower. Results are shown in Figure 4, where each of the violence factors are

plotted against the unstandardized residuals of the univariate model run with all factors as covariates, excluding relevant factor related to violence.



Figure 4: Effect of violence factors on masculinity preferences for Salvadoran male faces. a. Effect of men being dangerous to their children factor. b. Effect of the danger feelings/robberies factor.

Most of the other factors did not contribute to explaining women's masculinity preferences for Salvadoran male faces (namely age, access to media, individual illnesses, education; all $p > 0.20$). The health access factor did show a trend ($F(1,83)=3.41$, $p=0.069$, $\eta^2=0.042$). When women had more access to health they had a lower masculinity preference.

4.3 Men's masculinity preferences

In the univariate ANOVAs none of the variables/factors affected men's masculinity preferences for Salvadoran male faces (all $p > 0.19$). Preferences for European male faces were marginally influenced by the men being dangerous to their children factor ($F(1,65)=2.93$, $p=0.092$, $\eta^2=0.048$). Men who agreed more with men being dangerous to their children had a lower masculinity preference. None of the other variables/factors contributed significantly to explaining men's masculinity preferences for European male faces ($p > 0.11$).

5. Discussion

These data demonstrate that exposure to violence is relevant for women's but not for men's facial masculinity preferences for male faces. When women were exposed to more

violence, they had lower masculinity preferences for male faces. The results found here go against our initial prediction. Additionally, the effect of violence on women's masculinity preferences depended on the ethnicity of the stimuli used. When women felt more in danger and/or had experienced more robberies they showed reduced masculinity preferences for Salvadoran male faces but not European. When women agreed more with men being dangerous to their children, they had lower masculinity preferences for male faces regardless of the ethnicity of the face shown to them. Violence effects remained significant even after controlling for participant's sex and age as well as for factors related to health, education, and access to media. Furthermore, the violence factors (i.e., either reflecting experience of robberies and feelings of danger or thinking that men are dangerous to their children) explained significantly more of the variation in women's masculinity preferences than education, health, and access to media. Indeed these variables were found to be largely unrelated to women's masculinity preferences.

5.1 Violence effect on women's masculinity preferences

Masculine characteristics in men have been associated with more aggressive behaviour, cheating, dominance, and physical strength (Boothroyd et al., 2007; Booth & Dabbs, 1993; Jones et al., 2010; Fink et al., 2002). Hence, women's lower masculinity preferences when exposed to violence may reflect their fear of violence from men being directed towards them. Women may try to avoid masculine men who are likely to be aggressive and violent. According to this interpretation, women may value more low masculine traits in environments where avoiding violence is important, for example, places where partner violence is high. This argument is in line with research by Li et al., (2014) in which women's masculinity preferences were disrupted with images of male aggression towards females. Further research is needed in order to determine how fear of domestic violence may impact on masculinity preferences in Colombia and other populations.

5.1.1 Violence effects depending on ethnicity of stimuli

Thinking that men are dangerous to their children goes beyond the ethnicity of the stimulus used. European and Salvadoran male faces generated the same response pattern at the individual level. This was apparent in the lack of interaction between face stimuli ethnicity and the men being dangerous to their children factor on preferences. Less masculine European and Salvadoran male faces were preferred when women agreed more that men are dangerous to their children. These results may reflect women's strategy to protect their

family, preferring those men who are less likely to be violent and more likely to invest in their household. Women, relative to men, invest a lot more time and energy in their offspring (Trivers, 1972; Geary, 2000), hence, there would be a strong selective pressure to recognize any facial cues in men that relate to a violent, dangerous, or untrustworthy disposition (Stirrat & Perrett, 2010).

The effect of the danger feelings/robberies factor preferentially affected the Salvadoran stimuli. When women had higher danger feelings or experienced more robberies, they preferred less masculine Salvadoran male faces. Colombia and El Salvador are both Hispanic countries separated by 1200 km, their people look more similar to one another than to European faces (see Figure 6 for a comparison). This makes the Salvadoran stimuli more relevant to the everyday experiences of Colombian women. That is, the participants would be more likely to be exposed to danger from men similar to the Salvadoran than the European stimuli.

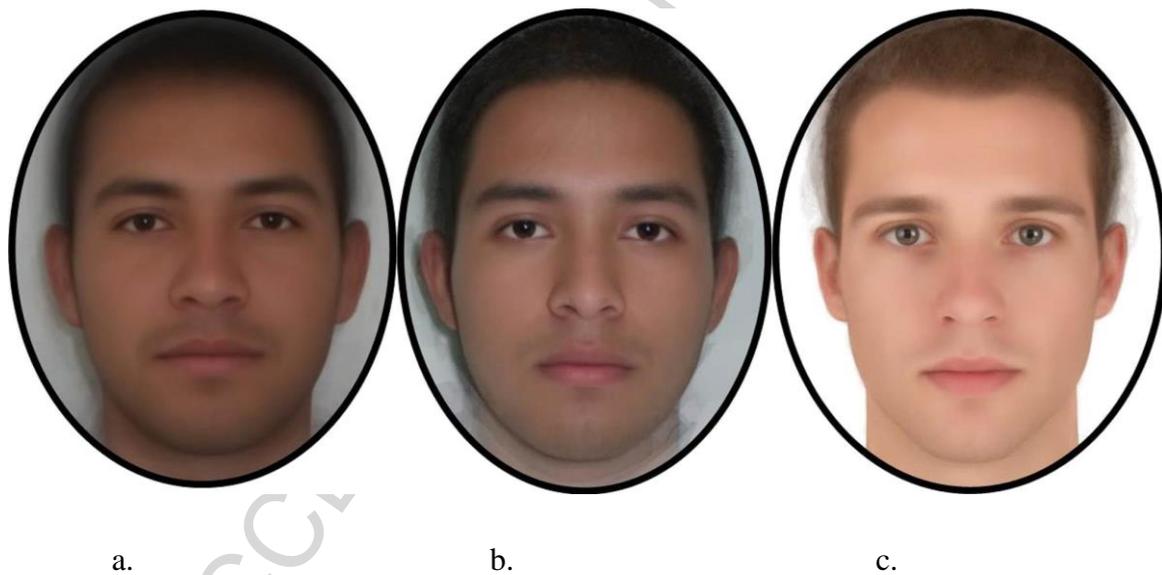


Figure 5: Men's facial averages (25 faces, average age 25). a. Colombian (facial images included here are from Bogota and nearby towns), b. rural Salvadoran and c. European.

5.2 Direction of violence effects

Several researchers (Puts, 2010; Brooks et al., 2011; Snyder et al., 2011; Fessler, Hollbrook, & Fleischman, 2015; Ryder et al., 2016) have suggested that women's masculinity preferences reflect their need for protection in violent environments. Brooks et al., (2011) found supporting evidence for this claim across 30 different countries using an

income inequality index and homicide rates as proxies of violence. Women living in countries with a higher income inequality preferred more masculine male faces. Our results, however, show the opposite tendency: women's masculinity preferences were lower when they had been more exposed to violence or when they agreed more that men are dangerous to their children. The discrepancy between our results and those of Brooks et al., (2011) may reflect level of analysis. The cross-cultural analysis by Brooks and colleagues was done at the population level, using aggregated indicators for the population as a whole, whereas the analysis here reveals variation in preferences at the individual level, within a population. The results from a country (or location of residence) level analysis, may conflate the effects of multiple factors (e.g., violence and pathogen load may correlate across countries, either or both could affect masculinity preferences). In fact, Snyder et al., (2011) found no effect for violence at the population level (i.e., neighbourhood crime) but did find an effect of self-assessed vulnerability to crime on women's formidability preferences. Perhaps, measures at the population level, can only be a mere approximation of an individual's real exposure to danger/violence. It may be that the larger the scale of the measure, the greater discordance between these measures and some individual's real experience.

Furthermore, Snyder et al., (2011) found that women who felt vulnerable to public violence preferred bodies and personality characteristics of formidable male partners. Our results do not necessarily contradict those results. We believe that women's preferences should differ depending on the source of violence. On one hand, if women fear, and are more likely to experience violence from strangers (e.g., public violence), they may prefer male partners who are more capable of offering protection, hence women would prefer more masculine/formidable males. On the other hand, if women fear, or have experienced violence within the family household, then they may prefer male partners who are less aggressive and more feminine in appearance. Our results may show effects of fear of a different type of violence than that studied by Snyder and colleagues. Both of our violence factors loaded on danger of violence inside the home. The danger feelings/robberies factor included feelings of danger in the home and the men being dangerous to their children also relates to danger within the home. Another possibility to explain the differences between our results and those of Snyder et al., (2011) is that women's desires for a mate may differ depending on the level of reflection when answering questions. Women might reflect more on the benefits and costs of masculinity when asked to think about characteristics in a potential mate (as Snyder et al.,

2011 assessed) than when asked to choose on the aesthetic difference between two types of face (as here).

Priming experiments (Little et al., 2011b, 2013) have also suggested that women prefer more masculine men when exposed to more violent environments. Little and colleagues found that when women were primed with images of male-male contests (e.g., boxing) their preferences for masculinity in male faces increased. These results, however, may reflect priming of women's preferences for muscularity, as a boxer's muscle mass is usually higher than average. Alternatively, priming may reveal more about short-term preferences or short-term adaptation to masculinity, both of which raise masculinity preferences.

5.3 Violence effects on men's masculinity preferences

Neither violence nor any other of the variables used in this analysis had an effect on men's masculinity preferences for male faces. However, there was a trend for men's masculinity preferences paralleling those of women (Burris & Little, 2006; Gangestad et al., 2002; Haselton & Gangestad, 2006), being lower when they considered men being dangerous to their children. Another possibility is that men prefer less masculine men because they recognize them as being less aggressive and more likely to invest in parental care, which may lead to better allies in protecting children.

6. General conclusion

Consistent with predictions from the trade-off theory (Thornhill & Gangestad, 1996; Gangestad & Simpson, 2000) we report an inverse relationship between women's facial masculinity preferences and violence, reflecting variation in experience of robberies/perceptions of danger and fear of men being dangerous to their children. Across Colombian women, as the fear/experience of violence increased, individuals' masculinity preferences decreased. While previous research has emphasized the effect of environmental variables (e.g., national health, income inequality, homicide rate) at the population level or the effect of experimental exposure of primes related to health and violence, our findings point out that mate preferences are also affected by individual perceptions and experiences of violence. The current and past studies reveal a gap in research regarding mate preferences: violence is multifaceted, being targeted at strangers as well as family members. Hence, more

detailed surveys are needed to distinguish how fear of violence from within or outside the household influences partner preferences.

7. Data Accessibility

All data underlying the findings presented here are fully available as supplementary online material.

8. Competing interests

The authors have declared that no competing interests exist.

9. Figure Captions

Figure 1: Example pairs of European (left) and Salvadoran (right) male facial stimuli. The left of each pair is feminized and the right is masculinized in shape.

Figure 2: Effect of face ethnicity: Stimulus face ethnicity effect depending on participants' sex.

Figure 3: The effect of men being dangerous to their children factor on women's masculinity preferences for European male faces (% trials choosing masculine faces).

Figure 4: Effect of violence factors on masculinity preferences for Salvadoran male faces. a. Effect of men being dangerous to their children factor. b. Effect of the danger feelings/robberies factor.

Figure 5: Men's facial averages (25 faces, average age 25). a. Colombian (facial images included here are from Bogota and nearby towns), b. rural Salvadoran and c. European.

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13. Appendix

Questionnaire

Spanish version

1. Cuál es su sexo?
2. Cuál es su orientación sexual? (1-7, 1 siendo completamente homosexual, 4 bisexual y 7 completamente heterosexual).
3. De qué país es usted?
4. Cuál es su edad?
5. Usted está en una relación ahorita? (Si/No)
6. Usted tiene hijos? (Si/No)
7. Cuantos hijos tiene usted?
8. Usted atendió el bachillerato? (Si/No)
9. Usted se graduó del bachillerato? (Si/No)
10. Usted atendió la universidad? (Si/No)
11. Usted tiene electricidad en su casa? (Si/No)
12. Usted tiene acceso al internet en su casa? (Si/No)
13. Tiene usted televisión en su casa?
14. Cuantas veces al año tiene usted acceso al internet? (1. Cada día, 2. Cada semana, 3. Cada mes, 4 cada tres meses, 5 cada 6 meses, 6. Anual y 7. Nunca).
15. Usted tiene acceso fácil a un hospital? (Si/No)
16. En promedio, cuantas veces al año se enferma usted?
17. Usted tiene agua potable en su casa? (Si/No)
18. Usted nació en un hospital? (Si/No)
19. Durante su niñez (antes de los 13 años) que tan frecuentemente una enfermedad grave lo obligo a estar en cama?
20. Donde vive usted? Escoja una de las siguientes opciones.
21. En general que tan seguro frente a la violencia se siente usted en los siguientes lugares? En una escala de 1 a 7, 1 siendo ningún riesgo a su seguridad y 7 alto riesgo a su seguridad.
 - En su casa
 - En su ciudad/pueblo
 - En el país
22. Que tan frecuentemente han intentado, robado o atacado físicamente a usted o algún conocido durante este último año?

23. Que tan de acuerdo está usted con la siguiente afirmación? “**Los hombres pueden ser un peligro para sus propios hijos**” (1-4, 1 completo desacuerdo – 4 completo acuerdo).

English version

1. What is your gender?
2. What is your sexual orientation? (1-7, 1 completely homosexual, 4 bisexual and 7 completely heterosexual)
3. Where are you from?
4. How old are you?
5. Are you currently in a relationship? (Yes/No)
6. Do you have any children? (Yes/No)
7. How many children do you have?
8. Did you attend high-school? (Yes/No)
9. Did you graduate from high-school? (Yes/No)
10. Did you attend university? (Yes/No)
11. Do you have electricity at home? (Yes/No)
12. Do you have television at home? (Yes/No)
13. Do you have internet at home? (Yes/No)
14. How many times a year do you have access to the internet? (1. every day, 2. every week, 3. every month, 4. every 3 months, 5. Every 6 months, 6. Once a year, 7. never)
15. Do you have easy access to a hospital? (Yes/No)
16. On average, how many times a year do you get sick?
17. Do you have potable water at home? (Yes/No)
18. Were you born at a hospital?
19. During your childhood (before age 13) how frequently did you get a serious illness that confined you to bed?
20. Where do you live?
 - At home
 - In the city/town
 - In the country
22. Over the last year, how frequently have you or anyone you know been victim of an actual or attempted mugging or physical attack?
23. How much do you agree with the following statement? “**Men are dangerous to their own children**” (1-4, 1 being not at all, 2 somewhat disagree, 3 somewhat agree, 4 fully agree).

Highlights

- Women who agree more with the statements “Men are dangerous to their children”, have lower masculinity preferences for both Salvadoran and European male faces.
- Women who feel more in danger at home/city/country and who have experienced more robberies have lower masculinity preferences for Salvadoran male faces.
- The only factors that contributed to explaining women’s masculinity preferences were the ones related to violence, the other factors related to education, health and access to media did not.