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1 **Pathogen disgust sensitivity and resource scarcity is associated with mate preference for**
2 **different waist-to-hip ratios, shoulder-to-hip ratios, and body mass index.**

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22

23

Abstract

24
25
26 Environmental factors, such as pathogen prevalence and resource scarcity, are thought to influence
27 mate preferences for traits related to health and resource provisioning potential. Specific body
28 dimensions, such as women's waist-to-hip-ratio (WHR), men's shoulder-to-hip ratio (SHR), and
29 body mass index (BMI) have also been theorised to be associated with health benefits, or ability to
30 deal with resource scarcity. Here, we test across two studies using different study designs whether
31 the effects of pathogen disgust sensitivity and socioeconomic status (SES; a negative proxy for
32 resource scarcity) on mate preferences extends to men's WHR preferences, women's SHR
33 preferences, and both sex's BMI preferences. Study 1 found that pathogen disgust significantly
34 negatively influenced men's WHR preference in female bodies, while SES was significantly
35 negatively associated with women's SHR and BMI preferences in male bodies. Study 2 found that
36 pathogen disgust negatively predicted men's WHR preference, and positively predicted women's
37 SHR preference, while SES negatively predicted men's WHR preference. Our findings support the
38 notion that body shapes are used as cues to health and likelihood of resource provision, and may
39 help explain inconsistencies in the literature regarding variation in body shapes preferences.

40

41 **Pathogen disgust sensitivity and resource scarcity is associated with mate preference for**
42 **different waist-to-hip ratios, shoulder-to-hip ratios, and body mass index.**

43
44 Mate choice is one of the most important predictors of evolutionary fitness (i.e., an
45 individual's contribution to the gene pool in the following generations). However, not all potential
46 partners confer the same benefits and costs, and the importance of these benefits and costs vary
47 depending of the circumstance. Therefore, it is evolutionarily beneficial to have a mechanism where
48 individuals can perceive environmental factors and adjust their mate preferences towards partners
49 that would be the most beneficial given the circumstances. Environmental factors, such as pathogen
50 prevalence and resource scarcity, have been proposed to influence mate preferences for a variety of
51 traits that are thought to be associated with health or resource provisioning potential, including
52 physical attractiveness (Gangestad & Buss, 1993; Lee et al., 2013; Young, Sacco, & Hugenberg,
53 2011) sexual dimorphism (i.e., the masculinity of men and the femininity of women; DeBruine,
54 Jones, Crawford, Welling, & Little, 2010; Jones, Fincher, Little, & DeBruine, 2013; Little, Cohen,
55 Jones, & Belsky, 2007; Little, DeBruine, & Jones, 2011), and good parental traits (Lee et al., 2013;
56 Lee & Zietsch, 2011).

57 Previous research (such as those cited above) has focused on preferences for broad, explicit
58 traits, for example, self-reported preferences for 'physical attractiveness' (Gangestad & Buss,
59 1993), or specific facial cues (which is thought to convey cues of mate quality; DeBruine, Jones,
60 Crawford, et al., 2010; Little et al., 2011), but recent work suggests that these effects may
61 generalise to more specific cues, such as voices and body shapes (Jones et al., 2013). Much like
62 with faces, the dimensions of an individual's body may be used as a cue to their suitability as a
63 potential mate (Gaullup & Frederick, 2010). Jones et al. (2013) found that in women higher
64 pathogen disgust was associated with preference for bodies rated as more masculine, though it is
65 unclear what specific body indices affected masculinity ratings. Here, we investigate whether
66 sensitivity to environmental factors, such as pathogen prevalence and resource scarcity, can

67 influence preferences for specific body indices previously purported to be important in mate choice,
68 namely women's waist-to-hip ratios (WHR), men's shoulder-to-hip ratios (SHR), and body mass
69 index (BMI).

70

71 *Waist-to-Hip Ratio*

72 WHR is the circumference of the waist measured at its narrowest point, divided by the
73 circumference of the hips measured at their widest point. WHR is highly sexually dimorphic, with
74 women typically having a lower WHR than men. Traditionally, WHR has been used as a measure
75 of female body shape as it represents the relative distribution of body fat on the body, which is
76 indicative of hormonal levels in the body. A lower WHR indicates greater levels of circulating
77 oestrogen, which stimulates fat deposits around the thighs and buttocks, while higher WHR is
78 associated with higher levels of testosterone, which encourages fat deposits in the abdomen
79 (DeRidder et al., 1990; Elbers, Asscheman, Seidell, Megens, & Gooren, 1997; Furnham, Tan, &
80 McManus, 1997).

81 WHR has been found to influence ratings of attractiveness, with initial studies finding men
82 preferred line-drawings of women with lower WHR (Singh, 1993; Singh & Young, 1995). Studies
83 have since shown that this is a robust effect, with this preference also found in photographs (Henss,
84 2000; Tovee & Cornelissen, 2001), as well as videos of women's bodies (Smith, Cornelissen, &
85 Tovee, 2007). Low WHRs are preferred even with minimal visual exposure (Schutzwohl, 2006), or
86 no visual input at all (Karremans, Frankenhuys, & Arons, 2010), and have also been found using
87 non self-report data, such as brain activity (Platek & Singh, 2010) and eye gaze patterns (Dural,
88 Cetinkaya, & Guelbetekin, 2008). This preference remains even when controlling for correlates of
89 WHR, such as BMI (Platek & Singh, 2010; Singh & Randall, 2007). Also in support of the notion
90 that low WHR are more attractive, women with low WHR report having more interest from the
91 opposite sex, and more sexual opportunities (Hughes & Gallup, 2003).

92 While most research in this area focuses on WHR, it remains controversial whether the ratio
93 itself conveys any special information. Recent studies suggest that WHR actually explains less
94 variation in attractiveness than mere waist circumference (Brooks, Shelly, Jordan, & Dixson, In
95 Press). Other research suggests that other body measures better explain attractiveness than WHR
96 (Brooks, Shelly, Fan, Zhai, & Chau, 2010), or that the influence of WHR is mainly accounted for
97 by confounds with BMI (Tovee, Maisey, Emery, & Cornelissen, 1999), which we discuss in more
98 detail below.

99 Men may use waist size or WHR as a cue to a number of evolutionarily beneficial traits.
100 First, low WHR may be a cue of good health, since lower WHR predicts better health outcomes
101 including lower risk of chronic diseases and premature death (Singh, 1993; Singh & Singh, 2006).
102 Lower WHR may also be a cue of higher fertility, with low WHR women reporting less difficulty
103 in conceiving (Jasienska, Ziomkiewicz, Ellison, Lipson, & Thune, 2004; Kaye, Folsom, Prineas,
104 Potter, & Gapstur, 1990), more regular menstrual cycles (van Hooff et al., 2000), and more
105 likelihood of success in artificial insemination and in vitro fertilisation (Wass, Waldenstrom,
106 Rossner, & Hellberg, 1997; Zaadstra et al., 1993). Offspring of women with a lower WHR may also
107 benefit indirectly, as low WHRs predict better infant health (Pawlowski & Dunbar, 2005), and
108 better cognitive ability (Lassek & Gaulin, 2008). Due to any number of these potential benefits, it is
109 likely to be advantageous for men to mate with a woman with a low WHR, and thus find lower
110 WHRs more attractive.

111 Despite these potential benefits, preferences across history and cultures have varied
112 considerably, which contradicts the notion that men have evolved a consistent preference for an
113 optimum WHR. While the majority of studies have been conducted with participants from modern
114 Western societies, participants from non-Western backgrounds have shown a preference for higher
115 WHR compared to Western participants (Sugiyama, 2004; Swami, Jones, Einon, & Furnham, 2009;
116 Tovee, Swami, Furnham, & Mangalparsad, 2006; Wetsman & Marlowe, 1999; Yu & Shepard,
117 1998). Historical evidence also shows that WHR preferences change across time, with higher WHR

118 more preferred in the past compared to contemporary preferences (Lamb, Jackson, Cassiday, &
119 Priest, 1993; Swami, Gray, & Furnham, 2007). This may suggest that there are costs associated
120 with choosing a partner with a low WHR, or that women with higher WHR may confer other
121 benefits that are more advantageous in non-Western cultures.

122 Indeed, a potential explanation for this discrepancy could lie in a trade-off men face when
123 choosing a partner. While women with narrow waists or a low WHR may confer indirect or direct
124 health benefits, women with larger waists or a higher WHR may be better equipped to compete for
125 resources and deal with food scarcity (Cashdan, 2008). Higher exposure to testosterone, which
126 results in deposition of fat around the waist, is associated in women with traits beneficial in
127 acquiring resources, such as being more aggressive (Dabbs & Hargrove, 1997; Harris, Rushton,
128 Hampson, & Jackson, 1996), more likely to express competitive feelings (Cashdan, 2003), and, in
129 Western cultures, may lead to being more career oriented (Udry, Morris, & Kovenock, 1995).

130 As a result, men could face a trade-off when choosing a mate between a low WHR
131 indicative of genetic health, compared to one with a higher WHR who is better equipped for
132 competing and acquiring resources. We could therefore predict that this trade-off is influenced by
133 environmental factors in evolutionarily beneficial ways, such that when pathogen prevalence is
134 salient men prefer a smaller WHR (as this is associated with increased health), and when resource
135 scarcity is salient a larger WHR (associated with ability to acquire resources) is preferred.

136

137 *Shoulder-to-Hip Ratio*

138 SHR refers to the relative size of the shoulders compared to the hips. Similar to WHR, SHR
139 is a cue of hormonal levels in the body, as the development of a higher SHR is dependent on
140 exposure to high levels of testosterone, which both stimulates the development of upper body
141 muscle (Bhasin, 2003), and structural growth in the shoulders (Kasperk et al., 1997). While not as
142 widely studied as WHR, women have been found to show a preference for wedge shaped bodies
143 (high SHR) as more attractive (Dijkstra & Buunk, 2001). Consistent with this notion, men with a

144 high SHR report greater interest from women as well as more sexual opportunities (Hughes &
145 Gallup, 2003).

146 Similar to low WHR women, high SHR men may convey many evolutionary benefits to
147 women who prefer them. First, a higher SHR is a sexually dimorphic trait, and some evidence
148 suggests that greater masculinity in men may be associated with health benefits (Gangestad,
149 Merriman, & Thompson, 2010; Rhodes, Chan, Zebrowitz, & Simmons, 2003; Thornhill &
150 Gangestad, 2006). Because of their putative association with good health, male masculinity may be
151 more highly valued by women in environments of high pathogen prevalence. Consistent with this,
152 individuals in countries with greater pathogen prevalence report greater preference for more
153 masculine male faces (DeBruine, Jones, Crawford, et al., 2010; Penton-Voak, Jacobson, & Trivers,
154 2004). Also, women primed with pathogen-related cues had a greater preference for masculine traits
155 and facial features (Lee & Zietsch, 2011; Little et al., 2011), and women with greater pathogen
156 disgust sensitivity have also been shown greater preference for facial masculinity (DeBruine, Jones,
157 Tybur, Lieberman, & Griskevicius, 2010; but see Lee et al., 2013). While more research has
158 focused on preference for masculinity in faces, pathogen avoidance has also been shown to
159 influence women's preference for voices and bodies perceived as masculine (Jones et al., 2013).
160 Assuming there is a similar link between SHR and health, women could benefit directly by
161 choosing a higher SHR partner, either through avoidance of pathogen transmission or having a
162 partner who is less likely to succumb to disease, or indirectly through producing offspring that
163 would inherit these health benefits (Frederick & Haselton, 2007; Tybur & Gangestad, 2011), though
164 this latter point is contentious (Lee et al., 2014; Scott, Clark, Boothroyd, & Penton-Voak, 2013).

165 Despite the potential health benefits, some studies have found only a weak, or inconclusive
166 preference for masculine traits (Komori, Kawamura, & Ishihara, 2009; Said & Todorov, 2011;
167 Scott, Pound, Stephen, Clark, & Penton-Voak, 2010; Thornhill & Gangestad, 2006), while others
168 find an overall preference for femininity (Boothroyd, Jones, Burt, & Perrett, 2007; Perrett et al.,
169 1998). This would suggest there is a cost in choosing a masculine male as a mate (Frederick &

170 Haselton, 2007). Indeed, masculine men are less likely to be sexually faithful, tend to prefer short-
171 term relationships (Boothroyd, Jones, Burt, DeBruine, & Perrett, 2008), and are rated as more
172 dominant (Watkins, DeBruine, Little, Feinberg, & Jones, 2012). As a result, women may face a
173 trade-off between choosing a masculine male with good health, versus a feminine male with good
174 parental quality.

175 Indeed, previous research also stipulates that in environments where resources (e.g. food,
176 shelter) are scarce, women prefer men with feminine features as these putatively associated with
177 relationship commitment and parental qualities (Lee et al., 2013; Lee & Zietsch, 2011; Little et al.,
178 2011; Watkins et al., 2012). Consistent with this, individual differences in socioeconomic status (a
179 negative proxy for resource scarcity) is negatively associated with preferences more oriented
180 towards feminine faces (Lee et al., 2013), and experimental studies have found that women primed
181 with cues of resource scarcity prefer more feminine faces (Little et al., 2007; Watkins et al., 2012)
182 or traits associated with parental quality (Lee & Zietsch, 2011). It could be the case that this trade-
183 off between good health and good parental qualities generalises to preference for
184 masculine/feminine body shape; however, in the case of SHR the opposite could also be predicted.
185 SHR is positively correlated with upper body strength, and in ancestral times, men with greater
186 SHR would be better equipped to provide adequate protection or be more competitive against other
187 males for resources (Gaullup & Frederick, 2010; Lassek & Gaulin, 2009; Puts, 2010). These in turn
188 would allow a better chance of survival for the choosing female and her offspring.

189 Therefore, based on previous theory and research, we could predict that when pathogen
190 prevalence is salient, women would prefer a greater SHR (as it is potentially associated with health
191 benefits); however, there is no clear expectation for how resource scarcity would influence
192 women's SHR preferences, because high SHR could be indicative of both poorer parental quality
193 and greater ability to compete for resources.

194

195

197 BMI refers to the weight of an individual scaled by height and has been used as an indicator
198 of the fat stores on one's body. Possessing fat stores is highly adaptive – during ancestral times
199 when food was not always plentiful, the ability to store energy in the form of body fat was highly
200 adaptive in order to bridge periods when food was scarce (Gaullup & Frederick, 2010; Nelson &
201 Morrison, 2005). Body fat stores also help in reducing the energetic demands of pregnancy and
202 lactation production (Bronson & Manning, 1991; Dufour & Sauther, 2002; Ellison, 2003).
203 However, despite these potential advantages, body fat appears to be disadvantageous for health,
204 particularly in fighting infection and disease with high body weight associated with impaired
205 immunocompetence response (Pawlowski, Nowak, Borkowska, & Drulis-Kawa, 2014; Rantala et
206 al., 2013; Tanaka et al., 1993; Tanaka, Isoda, Ishihara, Kimura, & Yamakawa, 2001).

207 Contemporary Western societies (or WEIRD societies; Henrich, Heine, & Norenzayan,
208 2010) possess a preoccupation with maintaining a slender figure; individuals report slender bodies
209 as ideal body shape for themselves and as preferred in partners (Swami et al., 2010). But in non-
210 Western cultures preferences for low BMIs are not as strong, and high BMIs are sometimes
211 preferred (Swami et al., 2010). The contemporary WEIRD aversion to body fat remains
212 unexplained in the evolutionary psychology literature (Gaullup & Frederick, 2010). A potential
213 explanation could come from variation in pathogen prevalence and resource scarcity between
214 societies. Body fat may serve a less adaptive role in current Western societies compared to non-
215 Western societies as resources are often plentiful and pathogen prevalence lower, decreasing the
216 necessity for stored energy or the importance of choosing a partner with good health.

217 Supporting the notion that BMI preference may be facultatively calibrated according to the
218 surrounding environment, Nelson and Morrison (2005) found that greater resource scarcity,
219 manipulated via financial or caloric dissatisfaction, significantly increases men's body weight
220 preferences in women. Also, preference for BMI appears to be malleable depending on cultural
221 factors; Tovee et al. (2006) found that African Zulus adopt Western preferences for body fat (i.e.,

222 thinner bodies) after moving to the United Kingdom. One interpretation of these findings is that
223 individuals may merely adopt the local cultural standards of beauty, but another non-exclusive
224 alternative is that BMI preferences shift plastically in response to local environmental factors, such
225 as pathogen prevalence and/or resource scarcity.

226 Based on this, we would predict that when health cues are salient, individuals would prefer a
227 smaller BMI. However, when resource cues are salient, individuals would show a greater
228 preference for larger BMIs.

229

230 *Current Research*

231 The current research aims to investigate whether individual differences in sensitivity to
232 pathogens or resource scarcity influences mate preference for different body shapes. We investigate
233 this by testing the association of individual levels of pathogen disgust sensitivity and socioeconomic
234 status (SES; a negative proxy for resource scarcity) with preference for different body shapes across
235 two studies.

236 While most of the literature cited so far concerns societal differences in environmental
237 threats, the current research focuses on individual differences in sensitivity to environmental cues of
238 pathogens and resource availability. Previous research has found that individual and societal
239 differences in health and resources are associated with mate preferences in consistent ways. Indeed,
240 both health at a societal level and individual pathogen disgust sensitivity have been predicted and
241 found to be associated with greater preference for facial masculinity in women (DeBruine, Jones,
242 Crawford, et al., 2010; Jones et al., 2013). This is thought to be because in both cases individuals
243 have increased salience of that threat, either through increased exposure (for societal differences) or
244 increased sensitivity (for individual differences).

245 In Study 1, we measure body preferences via attractiveness ratings, while Study 2 uses a
246 forced-choice paradigm. Based on the purported trade-offs individuals may face when choosing a
247 partner, we predict that men with greater pathogen disgust will favour bodies with narrower waists

248 and thus lower WHRs (we will refer to WHR throughout), while those with greater resource
249 scarcity will prefer higher WHRs. We also predict that women with greater pathogen disgust will
250 prefer males with broader shoulders and thus higher SHRs, while previous theory and findings do
251 not lead to unambiguous predictions of what effect (if any) resource scarcity will have on women's
252 SHR preference. We also predict that BMI preference will be negatively influenced by sensitivity to
253 pathogens, but positively influenced by resource scarcity, and that these effects will be independent
254 of those on WHR and SHR preferences. These predictions and theoretical rationale are shown in
255 Table 1.

256
257 - INSERT TABLE 1 HERE -

258 259 STUDY 1

260 261 Method

262 263 *Participants*

264 Participants were 300 male and 287 female volunteers from an online surveying site
265 (www.socialsci.com) who participated in return for redeemable store credit. The majority of
266 participants resided in the United States (75% of men, 80% of women), while the remainder of the
267 sample were from other Western countries (e.g., Canada, UK, Australia). Participation was
268 conditional on being heterosexual and not currently in a long-term relationship. Responses from 8
269 males and 2 females were removed as they completed the survey in an unrealistic time (<5
270 minutes), suggesting a lack of attention to the survey items. An additional 40 males and 47 females
271 were removed due to missing data on any of the key variables. The final samples included in
272 analyses were to 252 males ($M = 23.69$, $SD = 6.38$) and 238 females ($M = 23.62$, $SD = 6.43$), which

273 included a wide participant age range (18-59 years, though majoring of participants were under 40
274 years).

275

276 *Stimuli*

277 Participants were asked to rate opposite-sex, computer generated bodies that were based on
278 real body measurements (for more detail, see Brooks et al., In Press). For each sex, there were 5
279 source bodies that differed naturally within the “normal” range of BMI (i.e. neither underweight nor
280 obese). For the female bodies, we manipulated waist size of each source body by either subtracting
281 or adding one or two inches. These, together with the original (unmanipulated) body, created 5
282 levels of waist size (and thus WHR) for each body. Similarly with male bodies, shoulder width was
283 manipulated by either adding or subtracting one or two inches to the width of the shoulders,
284 creating 5 levels of shoulder width (and thus SHR) for each body.

285 This created 25 bodies of each sex for each opposite sex participant to rate. For each female
286 body, WHR was calculated by dividing the circumference around the hips from the circumference
287 of the waist, while SHR was calculated for each male body by dividing the circumference around
288 the hips from the width of the shoulders. BMI for each body was also calculated using area-
289 perimeter ratios (APRs) from 2D images of the bodies. APR has previously been shown to be a
290 good proxy for BMI from a 2D image (Tovee et al., 1999), and involves dividing the distance of the
291 outline of the body from the area the body takes up. The perimeter and area were measured in pixels
292 and pixels² respectively and were calculated using the GIMP software package. Bodies were
293 presented in a pseudo-random order in which two bodies derived from the same source body were
294 not presented consecutively. Participants rated each body on a 100-point sliding scale (0 = very
295 unattractive, 100 = very attractive). For example of bodies, see Figure 1.

296

297

- FIGURE 1 ABOUT HERE -

298

299 *Measures*

300 The procedure used in this studied mirrored a previous study investigating the effect of
301 sensitivity to pathogen and resource scarcity on mate preferences for facial attractiveness, sexual
302 dimorphism, and intelligence (Lee et al., 2013). Following the presentation of bodies, participants
303 were given the Three Domain Disgust Scale (Tybur, Lieberman, & Griskevicius, 2009), which is a
304 21-item questionnaire measuring participant’s disgust sensitivity across three domains: moral,
305 sexual, and pathogen disgust. Moral disgust refers to aversion towards social transgressions, such as
306 “Intentionally lying during a business transaction”. Sexual disgust measured aversion towards
307 sexual deviance or unwanted sexual contact, such as “Hearing two strangers having sex”. Pathogen
308 disgust refers to aversion to exposure to pathogen contagions that could threaten one’s health, such
309 as “Accidentally touching a person’s bloody cut”. Participants rated the degree to which they found
310 these statements disgusting on a 7-point scale (0=not disgusting at all; 6=extremely disgusting).

311 Participants were also given a 1-item SES measure (Adler, Epel, Castellazzo, & Ickovics,
312 2000), which asked participants to rate their perceived standing compared to others on the three
313 dimensions of SES: income, education, and occupation, on a 10 point scale (10=best off, 1=worst
314 off). While only one item, this measure has previously been shown to correlate with more objective
315 measures of SES (Adler et al., 2000). SES was used as a negative proxy for resource scarcity.

316

317 *Analysis*

318 Each participant rated 25 bodies, resulting in 6,300 and 5,950 observations for males and
319 females respectively. This data is hierarchical in nature, as each of the 25 attractiveness ratings
320 made by each participant (Level 1) are nested within the participant themselves (Level 2). As such,
321 we analysed the data using Hierarchical Linear Modelling (HLM) in the R software package. By
322 using HLM, we can assume that associations between attractiveness ratings and level 1 predictors
323 (the WHR/SHR, and the BMI of each body) differ for each participant, and can control for this (for
324 further description of the advantages of this technique, see Raudenbush & Bryk, 2002). We can also

325 test our hypothesis by determining whether the level 2 predictors (pathogen disgust and SES)
326 moderate these preferences. Separate analyses were conducted for men and women. The body
327 dimensions SHR/WHR (depending on sex) and BMI were entered as Level 1 predictors, while
328 participants' age, SES, and pathogen, moral and sexual disgust were entered at Level 2. Moral and
329 sexual disgust were included into the model in order to test whether any effect of disgust was
330 uniquely attributable to pathogen disgust. Participant age was also included in the model as a
331 control variable. We also ran a model that controlled for participants' ethnicity; however, this did
332 not influence the pattern of significance and we therefore only report the original analyses here. To
333 improve interpretability, all predictors were standardised before being entered into the model. See
334 the Supplementary Material for additional detail on the analyses conducted.

335

336

Results

337

338 The intra-class correlation (i.e., the proportion of the total variance on attractiveness
339 ratings that is between-raters as oppose to within-raters) on attractiveness rating was .31 and .36
340 for males and females respectively. For full information on the random effects from the HLM
341 analysis, see the Supplementary Materials.

342 The fixed effects from the HLM analysis are reported in Table 1. The intercept refers to
343 the average slope between the Level 1 predictors and participants' ratings of attractiveness.
344 Overall, men rating female bodies showed a preference for lower WHR, consistent with previous
345 findings. Also consistent with previous studies, women overall preferred men with higher SHR.
346 BMI preference differed as a function of sex. Overall, men preferred bodies with lower BMIs,
347 but women showed greater preference for men with higher BMIs.

348

349

- TABLE 2 ABOUT HERE -

350

351 *Association of pathogen disgust scores on WHR, SHR, and BMI preferences*

352 The hypothesised association between pathogen disgust and men's WHR preference was
353 supported, such that men with greater pathogen disgust showed a greater preference for bodies with
354 lower WHRs. This is specific to pathogen disgust, as no relationship was found with moral or
355 sexual disgust. However, the relationship between pathogen disgust and women's preference for
356 bodies with greater SHR, while in the predicted direction, was not significant. Pathogen disgust also
357 failed to have an association in BMI preference for both men and women. Interestingly, women's
358 moral disgust significantly positively predicted preference for higher BMI.

359

360 *Association of SES with WHR, SHR, and BMI preferences*

361 For men, SES did not significantly predict WHR or BMI preferences. However, women's
362 SES was significantly associated with preference for higher SHR, such that women with greater
363 resource scarcity (i.e., lower SES) preferred bodies with higher SHR. Further, women with greater
364 resource scarcity preferred bodies with a higher BMI, consistent with our predictions.

365

366 **STUDY 2**

367

368 **Method**

369

370 *Participants*

371 Participants were 150 male and 150 female volunteers recruited from www.socialsci.com,
372 who participated in return for redeemable store credit. Similar to Study 1, the majority of
373 participants were from the US (80% of men, 83% of women) while the remainder were from other
374 Western countries. Participation was conditional on being heterosexual and not currently in a long-
375 term relationship. Data was handled identically to Study 1; that is participants who completed the
376 survey in an unrealistic time (<5 minutes; 2 males) or were missing data on any variable were

377 removed from analysis (10 males, 26 females). This reduced the sample to 138 males ($M = 23.07$
378 years, $SD = 9.27$ years) and 124 females ($M = 24.78$ years, $SD = 7.20$ years).

379

380 *Stimuli*

381 Study 2 used a forced-choice paradigm where participants were shown pairs of bodies side-
382 by-side and asked to rate which body they found more attractive. Participants were shown the
383 opposite-sex, computer generated bodies used in Study 1. Each trial consisted of one of the five
384 source bodies paired with the same body that had been manipulated on WHR for female bodies or
385 SHR for male bodies. The manipulated bodies had either one inch added to or subtracted from the
386 circumference of the waist for female bodies, or one inch added to or subtracted from the width of
387 the shoulders for male bodies. This resulted in 10 trials where participants were asked to rate which
388 body they found more attractive on an 8-point scale (1 = right body is much more attractive, 8 = left
389 body is much more attractive). The order in which choices was presented, and whether the source
390 body was presented on the left or right side was randomised. Participants' preference for higher
391 WHR/SHR was calculated as the mean preference across all 10 trials.

392

393 *Materials*

394 As with Study 1, after completing the forced-choice task participants were given the Three
395 Domain Disgust Scale (Tybur et al., 2009) and the 1-item SES measure (Adler et al., 2000).

396

397

Results

398

399 Participants' age, SES, and pathogen, moral and sexual disgust were entered as predictors
400 into a regression with SHR/WHR preference as the outcome variable. Similar to Study 1, the
401 pattern of significance remained unchanged when controlling for participants' ethnicity; therefore,

402 only the original analyses are reported here. Men and women were analysed separately. The results
403 from the regression are reported in Table 2.

404

405 - TABLE 3 ABOUT HERE -

406

407 *Association of pathogen disgust scores with WHR and SHR preferences*

408 For both men rating female bodies and women rating male bodies, we found an association
409 with pathogen disgust and body preferences as predicted. Replicating key effects in Study 1, we
410 found that men higher in pathogen disgust preferred lower WHR, while women higher in pathogen
411 disgust preferred higher SHR. There was no effect of moral or sexual disgust on body shape
412 preferences for either sex, suggesting that this effect was specific to pathogen disgust.

413

414 *Association of SES scores with WHR and SHR preferences*

415 Men's SES was significantly associated with WHR preference, such that men with greater
416 resource scarcity (i.e., lower SES) preferred higher WHR. While women's SES influenced their
417 SHR preferences in the same direction found in Study 1 (i.e., women with greater resource scarcity
418 preferring higher SHR), this relationship was non-significant.

419

420

Discussion

421

422 In the current studies, we tested whether individual differences in pathogen avoidance or
423 resource scarcity are associated with body shape preferences. Overall, we found that individual
424 differences in pathogen disgust and SES were significantly associated with preferences for
425 relatively narrow female waists (low WHR), broad shoulders relative to male waist circumference
426 (high SHR), and lower body mass (BMI) in both sexes. This is in line with previous findings of

427 environmental factors influencing preference for cues in other domains, such as facial cues, and
428 also supports recent work suggesting that these effects extend to body cues (Jones et al., 2013).

429

430 *Men's WHR preferences*

431 Across both studies, we found the predicted association between men's pathogen disgust
432 and their preference for lower WHR (or, simply, smaller waists) in female partners. Since lower
433 WHR is associated with a number of health or fertility benefits (Jasienska et al., 2004; Kaye et al.,
434 1990; Pawlowski & Dunbar, 2005; Singh, 1993; Singh & Singh, 2006; van Hooff et al., 2000; Wass
435 et al., 1997; Zaadstra et al., 1993), this result may indicate that men use the distribution of body fat
436 on a woman's body as a cue to health and men high in pathogen avoidance are placing greater
437 importance on these benefits. We note that these effects cannot be explained by WHR covarying
438 with BMI, as we do not find the same effect when BMI was manipulated in Study 1.

439 We also find some evidence that resource scarcity may influence men's WHR preference in
440 the predicted direction in Study 2, such that a higher WHR is preferred in harsh environments.
441 Assuming that this relationship exists, this may be because women with higher WHR is associated
442 with higher levels of testosterone, which is thought to better equip these women to compete and
443 acquire resources to deal with scarcity (Cashdan, 2008). This would be advantageous for men
444 partnered with high WHR women, as well as for any mutual offspring during harsh times.
445 However, the relationship between men's resource scarcity and WHR preference was non-
446 significant in Study 1; therefore, we only provide partial support for this hypothesis.

447 Assuming such a relationship exists, our data could suggest that men face a trade-off
448 between women with a low WHR indicative of good health (which may benefit men directly or
449 indirectly), compared to women with a higher WHR that is better equipped for competing and
450 acquiring resources. This facultative calibration of preferences according to environmental cues is
451 similar to those found in other domains, such as preference for facial cues (Little et al., 2007; Little
452 et al., 2011), or explicitly stated traits (Lee & Zietsch, 2011). These findings could also explain

453 inconsistencies within the literature regarding historical and cultural variation on men's WHR
454 preferences. Fluctuations in environmental conditions (e.g., pathogen prevalence, resource scarcity,
455 or other factors not investigated here) shift the optimum WHR that is most evolutionarily beneficial,
456 which contribute to findings of higher WHR being preferred in non-Western participants
457 (Sugiyama, 2004; Swami et al., 2009; Wetsman & Marlowe, 1999; Yu & Shepard, 1998) or in the
458 past (Lamb et al., 1993; Swami et al., 2007), presumably because these environments were more
459 resource-scarce compared to modern WEIRD societies.

460

461 *Women's SHR preferences*

462 We also find evidence that environmental factors may influence women's SHR preference,
463 but this effect is less clear. While both studies found that pathogen disgust and SES influenced SHR
464 preference in the same directions, the pattern of significance was different between studies. In
465 Study 1, SHR preference was significantly, negatively associated with SES, while the effect of
466 pathogen disgust was non-significant. In Study 2, the reverse was true, where pathogen disgust
467 significantly, positively influence SHR preference, while the effect of SES was non-significant.
468 Because of this, discussion below that environmental factors may influence women's SHR
469 preferences is made tentatively.

470 If environmental factors do influence women's SHR preference, this may suggest that
471 women use SHR as a cue to evolutionarily beneficial traits. First, results from Study 2 suggest that
472 women may use high SHR as a cue to health; this is consistent with recent work that found an
473 association between women's facial masculinity preference and pathogen avoidance (DeBruine,
474 Jones, Crawford, et al., 2010; DeBruine, Jones, Tybur, et al., 2010; Jones et al., 2013; Little et al.,
475 2011; Penton-Voak et al., 2004), and also recent work suggesting that this effect may also
476 generalise to masculine body shape preferences (Jones et al., 2013). In combination with previous
477 results, our data suggests that masculine facial and body information may act as back-up cues to
478 health. Assuming there is a link between a SHR and health, women could benefit directly from

479 choosing a partner with cues to good health, either indirectly (assuming such traits are heritable), or
480 through direct avoidance of pathogen transmission, or by having a partner who is less likely to
481 succumb to disease (Jones et al., 2013).

482 Existing theory and research was ambiguous with regard to the expected direction of
483 association between resource scarcity and SHR preference. One possibility was that women may
484 use SHR as a cue of ability to acquire or compete for resources, which could be beneficial for
485 women whom resource scarcity is salient (Gaullup & Frederick, 2010; Lassek & Gaulin, 2009;
486 Puts, 2010). Our results are consistent with this idea, since women in more resource scarce
487 circumstances (i.e. low SES) preferred higher SHR male bodies. However, our results directly
488 oppose theory and prior research pointing in the other direction: masculine traits have been
489 associated with poor parental attributes in men (Boothroyd et al., 2008; Watkins et al., 2012), and
490 this has been used to successfully predict negative associations between resource scarcity and
491 preference for facial masculinity (Lee et al., 2013; Little et al., 2007; Watkins et al., 2012). Given
492 that high SHR is a masculine trait and is correlated with facial masculinity (Windhager, Schaefer, &
493 Fink, 2011), the opposing findings raise questions regarding how body masculinity combines with
494 other masculine traits to inform mate choice decisions.

495

496 *BMI preferences*

497 Study 1 found that pathogen disgust was not associated with BMI preferences in either men
498 or women. This suggests that BMI may not be used as a cue to immunocompetence, despite
499 previous work finding an association between high body weight and impaired immune functioning
500 (Pawlowski et al., 2014; Rantala et al., 2013; Tanaka et al., 1993; Tanaka et al., 2001). However,
501 we note that the stimuli used in both studies only included bodies that were within the normal range
502 of BMI. If the purported association between BMI and immunocompetence is only apparent when
503 considering bodies outside the normal range, then this could explain why we did not find an
504 association between participants' pathogen disgust and their BMI preferences.

505 However, we found that SES significantly influenced women's BMI preference consistent
506 with the prediction that higher BMI bodies would be preferred when resources are scarce, when fat
507 stores are more valuable. This is consistent with previous work that has found individual level
508 resource scarcity influences body weight preferences (Nelson & Morrison, 2005), and may help
509 explain Western societies' modern preoccupation with maintaining a slender figure presumably
510 because resources are plentiful in these environments, and thus the potential health costs of fat
511 storage may outweigh the benefits. However, as there was no significant influence of SES on men's
512 BMI preference, we only provide partial support for this theory.

513 Alternatively, since BMI is affected by muscle mass as well as fat mass, the finding that
514 women with lower SES prefer men with larger BMIs could reflect a greater preference for
515 muscularity when resources are scarce. Since men have greater relative quantities and variability in
516 fat free muscle mass compared to women (Hruschka, Rush, & Brewis, 2013; Wells, 2007), this may
517 explain why this association is significant for women's preferences of men's bodies but not the
518 reverse, and is consistent with the findings of women's preferences for SHR. Another alternative is
519 that the negative association between SES and men's preferences may simply reflect the differences
520 in average BMI across social class; that is, individuals from lower SES backgrounds may show a
521 preference for higher BMI bodies because, at least in Western societies, higher BMI bodies are
522 more prevalent in those with low SES. This is particularly true for women (Wang & Beydoun,
523 2007), which might explain why significant effects were found for men's preferences but not
524 women's.

525

526 *Limitations*

527 While here we focused on individual differences, we assume that salience of health and
528 resource threats would have similarly a similar effect on body preferences at an individual and
529 environmental level (as has been found for preferences in other domains; see DeBruine, Jones,
530 Crawford, et al., 2010; Jones et al., 2013). However, further research is needed to confirm this.

531 Also, while we use relative SES as a proxy for resource scarcity, this measure may not
532 reflect scarcity in terms of decreased access to food or shelter. As the participants were all from
533 Western countries (and had access to the Internet), it could be expected that all participants,
534 regardless of SES, would have plenty of access to caloric resources, as oppose to scarcity
535 experienced by individuals in poorer countries. This distinction between SES and actual scarcity
536 could explain why the results for resource scarcity are inconsistent between studies compared to the
537 associated with pathogen disgust.

538 Furthermore, we note that when manipulating WHR and SHR, we only altered waist
539 circumference for WHR and shoulder width for SHR (as opposed to also altering hip circumference
540 for both ratios); therefore, it could be the case that our findings reflect the importance of aspects of
541 shape, including absolute waist girth or shoulder width, other than the ratios we use throughout his
542 paper. Indeed, recent work on female body attractiveness that suggests that waist width is a better
543 predictor of female body attractiveness than WHR (Brooks et al, In Press), and reanalysis of our
544 results (provided in the supplementary materials) using only waist circumference yielded similar
545 results. However, reanalysis of our data on women's preferences for men suggests stronger
546 associations between individual differences and preference for SHR than mere preference for
547 shoulder width. Further work is needed to clarify more completely how individual differences alter
548 preferences for other body shape attributes that have been found to be important in attractiveness
549 judgements, such as bust, or limb length and girth (Brooks et al., 2010).

550

551 *Conclusion*

552 Our findings provide some support to the notion that body shape is used as a cue to health
553 and/or likelihood of resource provision. We note that some associations must be interpreted
554 cautiously; despite all associations being in predicted directions across both studies, the significance
555 of some effects was not consistent over the two studies.

556

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Figure Captions

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783 Figure 1. Examples of bodies used in Studies 1 and 2. Note there were a total of 5 source bodies
784 that varied on BMI.

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