

Women's Preferences for Masculinity in Male Faces Are Predicted by Material Scarcity, But Not Time or Psychological Scarcity

Evolutionary Psychology
July-September 2023: 1–7
© The Author(s) 2023
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/14747049231175073
journals.sagepub.com/home/evp



Anthony J. Lee and Nikita K. J. McGuire

Abstract

Facial femininity in men is purportedly used as a cue by women as a signal of parental quality and willingness to provide resources. Accordingly, in contexts where choosing a partner that will provide resources is more beneficial (e.g., when resources are scarce), women have shown an increase preference for facial femininity in male faces. However, domains of scarcity often covary, and it is, therefore, unclear whether these contextual shifts in facial masculinity/femininity preferences are specific to material scarcity (as implied by previous theory), or due to an unrelated domain of scarcity (e.g., time or psychological scarcity). Here, a sample of 823 women completed the Perceived Scarcity Scale, which measures three separate domains of scarcity: material scarcity, time scarcity, and psychological scarcity. Participants also rated the attractiveness of 42 male faces, which were measured on objective sexual dimorphism and perceived masculinity. Consistent with theory, material scarcity, and not time or psychological scarcity, was associated with a decreased preference for objective sexual dimorphism (i.e., an increased preference for facial femininity). This study provides evidence that women use sexual dimorphism as a cue to material resource provisioning potential when assessing men as a mate.

Keywords

attraction, mate preference, sexual dimorphism, resource scarcity, perceived scarcity, individual differences

Received 5 April 2023; accepted 25 April 2023

Introduction

Women purportedly face a trade-off between good health and good parental quality when choosing a male partner. Facial sexual dimorphism (e.g., the masculinity of male faces) is theorised to be associated with health and disease resistance (Rantala et al., 2012; Rhodes et al., 2003; Thornhill & Gangestad, 2006; but see Boothroyd et al., 2013). As such, it is proposed that women should show a preference for facial sexual dimorphism in men as these mates may incur benefits to their own fitness, either directly (e.g., through decreased exposure to pathogens) or indirectly (i.e., genetic health benefits inherited by offspring, Gangestad & Simpson, 2000; but see Lee et al., 2014). However, facial masculinity in men is also associated with poor parental quality; facial masculinity in men is associated with higher mating success (Hill et al., 2013; Kordsmeyer et al., 2018) and a greater preference for short-term relationships (Boothroyd et al., 2008). Men with masculine faces also report being less likely to be faithful in a

relationship (Boothroyd et al., 2008; Rhodes et al., 2005; Rhodes et al., 2013), and are generally perceived as less paternally investing (Boothroyd et al., 2007; Kruger, 2006). As such, when choosing a partner, women face a trade-off between choosing a facially masculine man with good health, or a more feminine man that may better provide resources to future offspring (Gangestad & Simpson, 2000; Holzleitner & Perrett, 2017).

Indeed, in contexts where having a healthy partner is more beneficial, women have been found to show an increase preference in male facial sexual dimorphism. For instance, increased

Faculty of Natural Sciences, Division of Psychology, University of Stirling, Stirling, Scotland

Corresponding Author:

Anthony J. Lee, Faculty of Natural Sciences, Division of Psychology, University of Stirling, Stirling, Scotland.
Email: anthony.lee@stir.ac.uk



Creative Commons CC BY: This article is distributed under the terms of the Creative Commons Attribution 4.0 License (<https://creativecommons.org/licenses/by/4.0/>) which permits any use, reproduction and distribution of the work without further permission provided the original work is attributed as specified on the SAGE and Open Access page (<https://us.sagepub.com/en-us/nam/open-access-at-sage>).

preference for facial masculinity is associated with lower local health indices (DeBruine et al., 2011; DeBruine, Jones, Crawford, et al., 2010). Experimental studies have found that increased facial masculinity preferences are associated with perceived exposure to pathogens (Little et al., 2011). There is also evidence that individual differences in pathogen disgust sensitivity is also associated with women's preferences for facial masculinity (DeBruine, Jones, Tybur, et al., 2010; Lee et al., 2013; Lee & Zietsch, 2015). However, note there is a growing body of literature that have failed to replicate these findings (Marcinkowska et al., 2019; McIntosh et al., 2017; Saribay et al., 2021; Tybur et al., 2022).

Conversely, in contexts where choosing a committed partner willing to invest and provide resources to potential offspring is more beneficial, women have been shown to have an increased preference for facial femininity. Indeed, experimental evidence suggests that women report a greater preference for facial femininity when primed with resource scarcity or environmental harshness (Little et al., 2007; Little et al., 2012; Lyons et al., 2016; Watkins et al., 2012). Also, greater preferences for facial femininity is associated with individual differences in SES or perceived financial hardship (Holzleitner & Perrett, 2017; Lee et al., 2013). More generally, the influence of resource scarcity appears to generalise to non-face preferences for traits purportedly associated with resource provisioning potential (Bradshaw et al., 2020; Lee et al., 2015; Lee & Zietsch, 2011; Marzoli et al., 2013; Nelson & Morrison, 2005; Pisanski & Feinberg, 2013). Similarly, previous research has proposed that women report a greater preference for facial femininity for long-term relationships compared to short-term relationships, where choosing a partner willing to invest is of greater importance (Clarkson et al., 2020; Little & Hancock, 2002; Little & Jones, 2012; Penton-Voak et al., 2003). However, the literature here is mixed as other studies have found a greater preference for masculine traits for long-term attractiveness (Dixon et al., 2018; Dixon et al., 2019; Dixon & Brooks, 2013; Stower et al., 2020).

When investigating effects of resource scarcity on mate choice, previous research often implies the effects are due to material scarcity (i.e., women show a greater preference for feminine male faces as these men are more likely to provide material resources beneficial for survival). However, material scarcity often covaries with other socio-economic factors, including other dimensions of scarcity. For instance, individuals who experience resource scarcity often face additional time pressures (time scarcity), or lack interpersonal or intrapersonal resources (e.g., social support, self-efficacy; psychological scarcity). Indeed, conceptualising scarcity comprising of several dimensions has been useful in the field of health psychology for accurately predicting perceived stress, health, quality of life, and mental health (DeSousa et al., 2018; DeSousa et al., 2020; DeSousa & Rego, 2022). Applying this model of scarcity to research investigating mate choice may provide insight into the exact selection pressures that may motivate shifts in preferences, and whether previously identified effects for facial masculinity preferences are specific to material

scarcity (and therefore reinforcing the theory that sexual dimorphism is used as a cue for resource provisioning potential), or potentially due to another domain of scarcity, or scarcity more generally.

Here, we assess the influence of resource scarcity on women's preference for facial masculinity using the Perceived Scarcity Scale (DeSousa et al., 2020), which separates scarcity into three domains: material scarcity, time scarcity, and psychological scarcity. According to previous theory, we hypothesise that increased material scarcity, but not time scarcity or psychological scarcity, would be negatively associated with facial masculinity preferences.

Methods

Participants

Participants were 823 volunteers who completed the online study recruited via posts on social media. Participants were removed from the sample if they did not report being female ($n = 4$) or did not report being attracted to men ($n = 17$). This resulted in a final sample of 802 women ($M = 24.75$ years, $SD = 7.87$ years). 35.08% of participants reported being single, 62.30% reported being in a committed relationship, while the remainder reported other.

Measures

Perceived Scarcity Scale. The Perceived Scarcity Scale (DeSousa et al., 2020) measures scarcity on three domains: material, time, and psychological scarcity. Participants rated their agreement to statements on a 7-point scale (1 = strongly disagree, 7 = strongly agree). The material scarcity subscale includes eight items, including "I have had my utilities (e.g., heat, water, etc.) turned off because I could not pay my bill". The time scarcity subscale also includes eight items, such as "I have enough time to engage in hobbies or engage in activities I enjoy" (reverse-coded). The psychological scarcity subscale includes 8 items, including "There are people in my life I can go to for support when I need it" (reverse-coded). Scores for each subscale were calculated separately such that higher scores indicated greater scarcity in that domain. The order that the items were shown was randomised for each participant.

Face Rating Task. Participants were presented with male faces sequentially and asked to rate how attractive they found them on a 9-point scale (1 = Very Unattractive, 9 = Very Attractive). Participants were presented with 42 male faces in a randomised order. For each face, two facial metrics scores were calculated: objective facial sexual dimorphism, and perceived masculinity. To calculate objective facial sexual dimorphism, we used the vector methods used in previous research (e.g., Holzleitner et al., 2014; Komori et al., 2011; Valenzano et al., 2006) using functions from the facefun R package (Holzleitner & DeBruine, 2021). This involved using geometric morphometric techniques to extract the face shape information from 155 landmarks delineated on all male and

female faces in the Chicago Face Database (Ma et al., 2015). Objective sexual dimorphism is then calculated by computing a multi-dimensional vector between the average female and average male face shapes from this sample, and then projecting each male face included in our study onto this vector. This produces a single score for each male face representing its position along the male–female face shape continuum. Scores are scaled such that higher scores indicate more male-like faces. Perceived masculinity scores were taken from the norming data accompanying the Chicago Face Database. As reported in Ma et al. (2015), trait ratings (including masculinity) were based on the average judgement of 1087 raters who rated each face on a 7-point scale (e.g., 1 = not at all masculine, 7 = extremely masculine). Raters were instructed to consider each target in relation to others of the same race and gender when making each judgement. Consistency among raters judging masculinity was high (Cronbach's $\alpha = .99$; Ma et al., 2015). For each participant, their preference for facial masculinity can be determined by comparing the facial metric scores (either objective sexual dimorphism or perceived masculinity) with their ratings of attractiveness.

Procedure

The Perceived Scarcity Scale and the Face Rating Task were included in a larger online survey investigating mate preferences. The order in which participants viewed each task was randomised.

Statistical Analysis

The data was analysed using mixed effects modelling and conducted in the R statistical software (R Core Team, 2013) using the lme4 (Bates et al., 2015) and lmerTest (Kuznetsova et al., 2015) packages. Separate models were conducted for objective facial sexual dimorphism and perceived facial masculinity. For both models, fixed effects estimates were included for material scarcity, time scarcity, and psychological scarcity, which were all z-standardised at the participant level. Predictors also included facial metrics scores (either objective sexual dimorphism or perceived masculinity), which were z-standardised at the stimulus level, as well as their interaction with material, time,

and psychological scarcity. For the hypothesis to be supported, we would expect a significant interaction between the facial metric scores and material scarcity (but not time nor psychological scarcity) such that preference for facial masculinity decreases when material scarcity increases. The models included a crossed random effect structure (DeBruine & Barr, 2021) with grouping factors for participant ID and stimulus ID. Random intercepts and slopes were specified maximally, according to Barr et al. (2013) and Barr (2013). The fixed effects estimate for each model are reported here; for full model specification and results, including random effects, see the supplementary materials on the OSF (<https://osf.io/bwvzu/>).

Results

Correlations between the Perceived Scarcity Scale subscales indicated that multicollinearity was not an issue ($r_s < .43$). The fixed effects estimates for models including objective sexual dimorphism and perceived masculinity are reported in Table 1 and Table 2 respectively. Across both models, the only significant effect was the interaction between objective sexual dimorphism and material scarcity in the predicted direction – as material scarcity increased, preference for facial sexual dimorphism in male faces decreased. It should be noted that, while not significant, the interaction between perceived masculinity and material scarcity was trending in the same direction. No other main effect or interaction was significant.

Discussion

As hypothesised, we found that only material scarcity, and not time or psychological scarcity, was negatively associated with preference for facial sexual dimorphism. This is consistent with the previous assumption that facial femininity in men is used as a cue to resource provisioning potential (Boothroyd et al., 2007, 2008; Kruger, 2006; Rhodes et al., 2005, 2013). These findings provides insight into the selection pressures underlying previous findings that women report an increase preference for facial femininity in contexts of resource scarcity (Holzleitner & Perrett, 2017; Lee et al., 2013; Little et al., 2007, 2012; Lyons et al., 2016; Watkins et al., 2012), and suggest that these effects are likely driven by material scarcity and not

Table 1. Fixed Effects Estimates from the Objective Sexual Dimorphism Model Predicting Attractiveness Ratings.

	Estimate (Std. Error)	t-value (approx. df)	p-value
Intercept	3.01 (.09)	34.81 (127.04)	< .001 ***
Objective Sexual Dimorphism	.00 (.08)	.03 (55.81)	.973
Material Scarcity	.05 (.04)	1.16 (811.99)	.248
Time Scarcity	-.01 (.04)	-.26 (799.59)	.797
Psychological Scarcity	-.00 (.05)	-.04 (801.60)	.970
Sexual Dimorphism \times Material Scarcity	-.02 (.01)	-2.48 (48.68)	.017*
Sexual Dimorphism \times Time Scarcity	.01 (.01)	1.23 (107.62)	.222
Sexual Dimorphism \times Psychological Scarcity	-.00 (.01)	-.16 (54.97)	.871

* $p < .05$, ** $p < .01$, *** $p < .001$

Table 2. Fixed Effects Estimates from the Perceived Masculinity Model Predicting Attractiveness Ratings.

	Estimate (Std. Error)	t-value (approx. df)	p-value
Intercept	3.01 (.08)	35.99 (121.91)	< .001 ***
Perceived Masculinity	.10 (.07)	1.58 (14.78)	.135
Material Scarcity	.05 (.04)	1.16 (811.17)	.246
Time Scarcity	-.01 (.04)	-.25 (798.51)	.801
Psychological Scarcity	-.00 (.04)	-.03 (800.24)	.973
Masculinity × Material Scarcity	-.02 (.01)	-1.95 (76.47)	.055
Masculinity × Time Scarcity	.01 (.02)	.84 (205.04)	.403
Masculinity × Psychological Scarcity	-.01 (.01)	-1.47 (85.44)	.146

* $p < .05$, ** $p < .01$, *** $p < .001$

scarcity more generally. Our results also do not support possible alternative explanations; for example, in harsh environments, women may experience greater psychological scarcity and perhaps show a greater preference for facial femininity as feminine men are often perceived as being warm and compassionate (Buckingham et al., 2006; Wen et al., 2020).

Despite our findings being consistent with the predominant theory, there is a growing body of literature that has not replicated the association between resource scarce ecological conditions and women's facial sexual dimorphism preferences (Batres & Perrett, 2016; Dixson et al., 2017; Marcinkowska et al., 2019; Saribay et al., 2021). There has also been the suggestion that in some circumstances (e.g., environments where intrasexual competition is high) masculine men may be preferred more as they are more able to procure resources (Brooks et al., 2011; Little et al., 2012; Mefodeva et al., 2020; Puts, 2010). The results from this study may help reconcile this divergent literature – isolating material scarcity, rather than using broader indices of socio-economic position or manipulations where separate domains of scarcity are likely to confounded, may help better identify the effect.

Added to the complication is that the observed effects from our study are small - the change in marginal R^2 (i.e., the proportion variance in attractiveness ratings explained by the fixed effects of the model) between objective sexual dimorphism models with and without material scarcity is small (Δ marginal $R^2 = .002$). This raises the question on whether such an effect is biologically meaningful; that is, is the effect likely to have a meaningful impact on the phenotype. Particularly since other factors, such as genetics, have been shown to have a much larger influence on women's preference for facial masculinity (Zietsch et al., 2015).

Another caveat to consider is the levels of resource scarcity experienced by participants in our study. While we found good variability on the material scarcity subscale of the Perceived Scarcity Scale (the full range of the scale was represented in the sample), the distribution was skewed such that much of the sample reported low material scarcity. This could be expected,

as participants, at a minimum, required Internet access to participate in the study, and the sample likely was recruited predominately from a Western population. As such, including a wider experience of material scarcity would produce results that would better generalise to other populations. Indeed, some evidence suggests that resource scarcity may not impact preference in non-Western populations (Saribay et al., 2021).

One advantage of our study is that we distinguish between objective sexual dimorphism and perceived masculinity. This is potentially important as the research literature to this point often considers these interchangeable. While there was a positive correlation between the two in our stimuli set ($r = .53$), we found that the estimated material scarcity coefficients were of similar magnitudes, even though the effect for objective sexual dimorphism was significant while the effect for perceived masculinity was not.

In conclusion, our results suggest that previous results of resource scarcity moderating women's preference for facial masculinity is specific to material scarcity. While this finding is consistent with previous theories, there are still unanswered questions that future research should address.


Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iD

Anthony J. Lee  <https://orcid.org/0000-0001-8288-3393>

Supplemental Material

Supplemental material for this article is available online.

References

- Barr, D. J. (2013). Random effects structure for testing interactions in linear mixed-effects models. *Frontiers in Psychology*, 4, 328. <https://doi.org/10.3389/fpsyg.2013.00328>
- Barr, D. J., Levy, R., Scheepers, C., & Tily, H. J. (2013). Random effects structure for confirmatory hypothesis testing: Keep it maximal. *Journal of Memory and Language*, 68(3), 255–278. <https://doi.org/10.1016/j.jml.2012.11.001>
- Bates, D., Mächler, M., Bolker, B. M., & Walker, S. C. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, 67(1), 1–48. <https://doi.org/10.18637/jss.v067.i01>
- Batres, C., & Perrett, D. I. (2016). How the harsh environment of an army training camp changes human (homo sapiens) facial preferences. *Ethology*, 123(1), 61–68. <https://doi.org/10.1111/eth.12571>
- Boothroyd, L. G., Jones, B. C., Burt, D. M., DeBruine, L. M., & Perrett, D. I. (2008). Facial correlates of sociosexuality. *Evolution and Human Behavior*, 29(3), 211–218. <https://doi.org/10.1016/j.evolhumbehav.2007.12.009>

- Boothroyd, L. G., Jones, B. C., Burt, D. M., & Perrett, D. I. (2007). Partner characteristics associated with masculinity, health and maturity in male faces. *Personality and Individual Differences*, 43(5), 1161–1173. <https://doi.org/10.1016/j.paid.2007.03.008>
- Boothroyd, L. G., Scott, I. M., Gray, A. W., Coombes, C. I., & Pound, N. (2013). Male facial masculinity as a cue to health outcomes. *Evolutionary Psychology*, 11(5), 1044–1058. <https://doi.org/10.1177/147470491301100508>
- Bradshaw, H. K., Rodeheffer, C. D., & Hill, S. E. (2020). Scarcity, sex, and spending: Recession cues increase women's desire for men owning luxury products and men's desire to buy them. *Journal of Business Research*, 120, 561–568. <https://doi.org/10.1016/j.jbusres.2019.07.021>
- Brooks, R., Scott, I. M., Maklakov, A. A., Kasumovic, M. M., Clark, A. P., & Penton-Voak, I. S. (2011). National income inequality predicts women's preferences for masculinized faces better than health does. *Proceedings of the Royal Society B: Biological Sciences*, 278(1707), 810–812. <https://doi.org/10.1098/rspb.2010.0964>
- Buckingham, G., DeBruine, L. M., Little, A. C., Welling, L. L. M., Conway, C. A., Tiddeman, B. P., & Jones, B. C. (2006). Visual adaptation to masculine and feminine faces influences generalized preferences and perceptions of trustworthiness. *Evolution and Human Behavior*, 27(5), 381–389. <https://doi.org/10.1016/j.evolhumbehav.2006.03.001>
- Clarkson, T. R., Sidari, M. J., Sains, R., Alexander, M., Harrison, M., Mefodeva, V., Pearson, S., Lee, A. J., & Dixon, B. J. W. (2020). A multivariate analysis of women's mating strategies and sexual selection on men's facial morphology. *Royal Society Open Science*, 7(1), 191209. <https://doi.org/10.1098/rsos.191209>
- DeBruine, L. M., & Barr, D. J. (2021). Understanding mixed-effects models through data simulation. *Advances in Methods and Practices in Psychological Science*, 4(1), 2515245920965119. <https://doi.org/10.1177/2515245920965119>
- DeBruine, L. M., Jones, B. C., Crawford, J. R., Welling, L. L. M., & Little, A. C. (2010). The health of a nation predicts their mate preferences: Cross-cultural variation in women's preferences for masculinized male faces. *Proceedings of the Royal Society B: Biological Sciences*, 277(1692), 2405–2410. <https://doi.org/10.1098/rspb.2009.2184>
- DeBruine, L. M., Jones, B. C., Little, A. C., Crawford, J. R., & Welling, L. L. M. (2011). Further evidence for regional variation in women's masculinity preferences. *Proceedings of the Royal Society B: Biological Sciences*, 278(1707), 813–814. <https://doi.org/10.1098/rspb.2010.2200>
- DeBruine, L. M., Jones, B. C., Tybur, J. M., Lieberman, D., & Griskevicius, V. (2010). Women's preferences for masculinity in male faces are predicted by pathogen disgust, but not moral or sexual disgust. *Evolution and Human Behavior*, 31(1), 69–74. <https://doi.org/10.1016/j.evolhumbehav.2009.09.003>
- DeSousa, M., Peterman, A. H., & Reeve, C. L. (2018). An initial model of scarcity. *Qualitative Psychology*, 5(1), 59–76. <https://doi.org/10.1037/qup0000077>
- DeSousa, M., Reeve, C. L., & Peterman, A. H. (2020). Development and initial validation of the Perceived Scarcity Scale. *Stress and Health*, 36(2), 131–146. <https://doi.org/10.1002/smi.2908>
- DeSousa, M., & Rego, K. (2022). Perceived scarcity across sociodemographic backgrounds predicts self-reported health. *European Journal of Health Psychology*, 30(2), 74–86. <https://doi.org/10.1027/2512-8442/a000122>
- Dixon, B. J. W., & Brooks, R. C. (2013). The role of facial hair in women's perceptions of men's attractiveness, health, masculinity and parenting abilities. *Evolution and Human Behavior*, 34(3), 236–241. <https://doi.org/10.1016/j.evolhumbehav.2013.02.003>
- Dixon, B. J. W., Blake, K. R., Denson, T. F., Gooda-Vossos, A., O'Dean, S. M., Sulikowski, D., Rantala, M. J., & Brooks, R. C. (2018). The role of mating context and fecundability in women's preferences for men's facial masculinity and beardedness. *Psychoneuroendocrinology*, 93, 90–102. <https://doi.org/10.1016/j.psyneuen.2018.04.007>
- Dixon, B. J. W., Kennedy-Costantini, S., Lee, A. J., & Nelson, N. L. (2019). Mothers are sensitive to men's beards as a potential cue of paternal investment. *Hormones and Behavior*, 113, 55–66. <https://doi.org/10.1016/j.yhbeh.2019.04.005>
- Dixon, B. J. W., Little, A. C., Dixon, H. G. W., & Brooks, R. C. (2017). Do prevailing environmental factors influence human preferences for facial morphology? *Behavioral Ecology*, 28(5), 1217–1227. <https://doi.org/10.1093/beheco/arx067>
- Gangestad, S. W., & Simpson, J. A. (2000). The evolution of human mating: Trade-offs and strategic pluralism. *Behavioural and Brain Sciences*, 23(4), 573–587. <https://doi.org/10.1017/S0140525X0000337X>
- Hill, A. K., Hunt, J., Welling, L. L., Cardenas, R. A., Rotella, M. A., Wheatley, J. R., Dawood, K., & Shriver, M. D., & D. A. Puts (2013). Quantifying the strength and form of sexual selection on men's traits. *Evolution and Human Behavior*, 34(5), 334–341. <https://doi.org/10.1016/j.evolhumbehav.2013.05.004>
- Holzleitner, I. J., & DeBruine, L. M. (2021). facefun (Version 0.0.0.900). <https://iholzleitner.github.io/facefun/index.html>
- Holzleitner, I. J., Hunter, D. W., Tiddeman, B. P., Seck, A., Re, D. E., & Perrett, D. I. (2014). Men's facial masculinity: When (body) size matters. *Perception*, 43(11), 1191–1202. <https://doi.org/10.1068/p7673>
- Holzleitner, I. J., & Perrett, D. I. (2017). Women's preferences for men's facial masculinity: Trade-off accounts revisited. *Adaptive Human Behavior and Physiology*, 3, 304–320. <https://doi.org/10.1007/s40750-017-0070-3>
- Komori, M., Kawamura, S., & Ishihara, S. (2011). Multiple mechanisms in the perception of face gender: Effect of sex-irrelevant features. *Journal of Experimental Psychology: Human Perception and Performance*, 37(3), 626–633. <https://doi.org/10.1037/a0020369>
- Kordmeyer, T. L., Hunt, J., Puts, D. A., Ostner, J., & Penke, L. (2018). The relative importance of intra- and intersexual selection on human male sexually dimorphic traits. *Evolution and Human Behavior*, 39(4), 424–436. <https://doi.org/10.1016/j.evolhumbehav.2018.03.008>
- Kruger, D. J. (2006). Male facial masculinity influences attributions of personality and reproductive strategy. *Personal Relationships*, 13(4), 451–463. <https://doi.org/10.1111/j.1475-6811.2006.00129.x>
- Kuznetsova, A., Brockhoff, P. B., & Christensen, R. H. B. (2015). lmerTest: Tests for random and fixed effects for linear mixed effect models. <https://CRAN.R-project.org/package=lmerTest>
- Lee, A. J., Brooks, R. C., Potter, K. J., & Zietsch, B. P. (2015). Pathogen disgust sensitivity and resource scarcity are associated with mate

- preference for different waist-to-hip ratios, shoulder-to-hip ratios, and body mass index. *Evolution and Human Behavior*, 36(6), 480–488. <https://doi.org/10.1016/j.evolhumbehav.2015.07.002>
- Lee, A. J., Dubbs, S. L., Kelly, A. J., von Hippel, W., Brooks, R. C., & Zietsch, B. P. (2013). Human facial attributes, but not perceived intelligence, are used as cues of health and resource provision potential. *Behavioral Ecology*, 24(3), 779–787. <https://doi.org/10.1093/beheco/ars199>
- Lee, A. J., Mitchem, D. G., Wright, M. J., Martin, N. G., Keller, M. C., & Zietsch, B. P. (2014). Genetic factors that increase male facial masculinity decrease facial attractiveness of female relatives. *Psychological Science*, 25(2), 476–484. <https://doi.org/10.1177/0956797613510724>
- Lee, A. J., & Zietsch, B. P. (2011). Experimental evidence that women's mate preferences are directly influenced by cues of pathogen prevalence and resource scarcity. *Biology Letters*, 7(6), 892–895. <https://doi.org/10.1098/rsbl.2011.0454>
- Lee, A. J., & Zietsch, B. P. (2015). Women's pathogen disgust predicting preference for facial masculinity may be specific to age and study design. *Evolution and Human Behavior*, 36(4), 249–255. <https://doi.org/10.1016/j.evolhumbehav.2014.12.001>
- Little, A. C., Cohen, D. L., Jones, B. C., & Belsky, J. (2007). Human preferences for facial masculinity change with relationship type and environmental harshness. *Behavioral Ecology and Sociobiology*, 61, 967–973. <https://doi.org/10.1007/s00265-006-0325-7>
- Little, A. C., DeBruine, L. M., & Jones, B. C. (2011). Exposure to visual cues of pathogen contagion changes preferences for masculinity and symmetry in opposite-sex faces. *Proceedings of the Royal Society B: Biological Sciences*, 278(1714), 2032–2039. <https://doi.org/10.1098/rspb.2010.1925>
- Little, A. C., DeBruine, L. M., & Jones, B. C. (2012). Environment contingent preferences: Exposure to visual cues of direct male-male competition and wealth increase women's preferences for masculinity in male faces. *Evolution and Human Behavior*, 34(3), 193–200. <https://doi.org/10.1016/j.evolhumbehav.2012.11.008>
- Little, A. C., & Hancock, P. J. B. (2002). The role of masculinity and distinctiveness in judgments of human male facial attractiveness. *British Journal of Psychology*, 93(4), 451–464. <https://doi.org/10.1348/000712602761381349>
- Little, A. C., & Jones, B. C. (2012). Variation in facial masculinity and symmetry preferences across the menstrual cycle is moderated by relationship context. *Psychoneuroendocrinology*, 37(7), 999–1008. <https://doi.org/10.1016/j.psyneuen.2011.11.007>
- Lyons, M., Marcinkowska, U., Moisey, V., & Harrison, N. (2016). The effects of resource availability and relationship status on women's preference for facial masculinity in men: An eye-tracking study. *Personality and Individual Differences*, 95, 25–28. <https://doi.org/10.1016/j.paid.2016.02.025>
- Ma, D. S., Correll, J., & Wittenbrink, B. (2015). The Chicago face database: A free stimulus set of faces and norming data. *Behavior Research Methods, Instruments, & Computers*, 47, 1122–1135. <https://doi.org/10.3758/s13428-014-0532-5>
- Marcinkowska, U. M., Rantala, M. J., Lee, A. J., Kozlov, M. V., Aavik, T., Cai, H., Contreras-Garduño, J., David, O. A., Kaminski, G., Li, N. P., Onyishi, I. E., Prasai, K., Pazhoohi, F., Prokop, P., Cardozo, S. L. R., Sydney, N., Taniguchi, H., Krams, I., & Dixon, B. J. W. (2019). Women's preference for men's facial masculinity are strongest under favourable ecological conditions. *Scientific Reports*, 9(3387), 1–10.
- Marzoli, D., Moretto, F., Monti, A., Tocci, O., Roberts, S. C., & Tommasi, L. (2013). Environmental influences on mate preference as assessed by a scenario manipulation experiment. *PLoS ONE*, 8(9), e74282. <https://doi.org/10.1371/journal.pone.0074282>
- McIntosh, T. L., Lee, A. J., Sidari, M. J., Stower, R. E., Sherlock, J. M., & Dixon, B. J. (2017). Microbes and masculinity: Does exposure to pathogenic cues alter women's preferences for male facial masculinity and beardedness? *PLoS ONE*, 12(6), e0178206. <https://doi.org/10.1371/journal.pone.0178206>
- Mefodeva, V., Sidari, M. J., Chau, H., Fitzsimmons, B., Antoine, G., Clarkson, T. R., Pearson, S., Lee, A. J., & Dixon, B. J. W. (2020). Multivariate intra-sexual selection on men's perceptions of male facial morphology. *Adaptive Human Behavior and Physiology*, 6, 143–169. <https://doi.org/10.1007/s40750-020-00128-2>
- Nelson, L. D., & Morrison, E. R. (2005). The symptoms of resource scarcity: Judgments of food and finances influence preferences for potential partners. *Psychological Science*, 16(2), 167–173. <https://doi.org/10.1111/j.0956-7976.2005.00798.x>
- Penton-Voak, I. S., Little, A. C., Jones, B. C., Burt, D. M., Tiddeman, B. P., & Perrett, D. I. (2003). Female condition influences preferences for sexual dimorphism in faces of male humans (*Homo sapiens*). *Journal of Comparative Psychology*, 117(3), 264–271. <Go to ISI>://000185458600004. <https://doi.org/10.1037/0735-7036.117.3.264>
- Pisanski, K., & Feinberg, D. R. (2013). Cross-cultural variation in mate preferences for averageness, symmetry, body size, and masculinity. *Cross-Cultural Research*, 47(2), 162–197. <https://doi.org/10.1177/1069397112471806>
- Puts, D. A. (2010). Beauty and the beast: Mechanisms of sexual selection in humans. *Evolution and Human Behavior*, 31(3), 157–175. <https://doi.org/10.1016/j.evolhumbehav.2010.02.005>
- Rantala, M. J., Moore, F. R., Skrinka, I., Krama, T., Kivleniece, I., Kecko, S., & Krams, I. (2012). Evidence for the stress-linked immunocompetence handicap hypothesis in humans. *Nature Communications*, 3(694), 1–5. <https://doi.org/10.1038/ncomms1696>
- R Core Team (2013). *A language and environment for statistical computing*. R Foundation for Statistical Computing.
- Rhodes, G., Chan, J., Zebrowitz, L. A., & Simmons, L. W. (2003). Does sexual dimorphism in human faces signal health? *Proceedings of the Royal Society of London, B*, 270, S93–S95. <https://doi.org/10.1098/rsbl.2003.0023>
- Rhodes, G., Morley, G., & Simmons, L. W. (2013). Women can judge sexual unfaithfulness from unfamiliar men's faces. *Biology Letters*, 9(1), 20120908. <https://doi.org/10.1098/rsbl.2012.0908>
- Rhodes, G., Simmons, L. W., & Peters, M. (2005). Attractiveness and sexual behavior: Does attractiveness enhance mating success? *Evolution and Human Behavior*, 26(2), 186–201. <https://doi.org/10.1016/j.evolhumbehav.2004.08.014>
- Saribay, S. A., Tureček, P., Paluch, R., & Kleisner, K. (2021). Differential effects of resource scarcity and pathogen prevalence on heterosexual women's facial masculinity preferences. *Evolutionary Human Sciences*, 3, e48. <https://doi.org/10.1017/ehs.2021.42>
- Stower, E. R., Lee, A. J., McIntosh, T. L., Sidari, M. J., Sherlock, J. M., & Dixon, B. J. W. (2020). Mating strategies and the masculinity

- paradox: How relationship context, relationship status, and socio-sexuality shape women's preferences for facial masculinity and beardedness. *Archives of Sexual Behavior*, 49, 809–820. <https://doi.org/10.1007/s10508-019-1437-2>
- Thornhill, R., & Gangestad, S. W. (2006). Facial sexual dimorphism, developmental stability, and susceptibility to disease in men and women. *Evolution and Human Behavior*, 27(2), 131–144. <https://doi.org/10.1016/j.evolhumbehav.2005.06.001>
- Tybur, J. M., Jones, B. C., Holleitner, I. J., Lee, A. J., Fan, L., & DeBruine, L. M. (2022). Re-evaluating the relationship between pathogen avoidance and preferences for facial symmetry and sexual dimorphism: A registered report. *Evolution and Human Behavior*, 43(3), 212–223. <https://doi.org/10.1016/j.evolhumbehav.2022.01.003>
- Valenzano, D. R., Mennucci, A., Tartarelli, G., & Cellerino, A. (2006). Shape analysis of female facial attractiveness. *Vision Research*, 46(8-9), 1282–1291. <https://doi.org/10.1016/j.visres.2005.10.024>
- Watkins, C. D., DeBruine, L. M., Little, A. C., Feinberg, D. R., & Jones, B. C. (2012). Priming concerns about pathogen threat versus resource scarcity: Dissociable effects on women's perceptions of men's attractiveness and dominance. *Behavioral Ecology and Sociobiology*, 66, 1549–1556. <https://doi.org/10.1007/s00265-012-1408-2>
- Wen, F., Zuo, B., Ma, S., Xu, Y., Coley, J. D., & Wang, Y. (2020). Do we see masculine faces as competent and feminine faces as warm? Effects of sexual dimorphism on facial perception. *Evolutionary Psychology*, 18(4), 1474704920980642. <https://doi.org/10.1177/1474704920980642>
- Zietsch, B. P., Lee, A. J., Sherlock, J. M., & Jern, P. (2015). Variation in women's preferences regarding male facial masculinity is better explained by genetic differences than by previously identified context-dependent effects. *Psychological Science*, 26(9), 1440–1448. <https://doi.org/10.1177/0956797615591770>