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4 The attractive side of trustworthiness: Effects of relationship context and social
5 interaction anxiety on face preferences

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31

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Abstract

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Keywords:

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Previous studies have highlighted the influence of conditional mating strategies in attractiveness preferences. “Good genes” and dominance cues are perceived as attractive when considering short-term relationships. In contrast, cues for better parenting abilities and trustworthiness are considered more attractive when participants ponder a long-term relationship. We investigated women’s and men’s attractiveness preferences in other-sex faces that were structurally altered along a continuum of apparent trustworthiness. Faces were adjusted in shape towards the perceived trustworthy-untrustworthy extremes defined on the basis of previously created prototypes. We anticipated that perceived trustworthiness would be more important for long-term than short-term relationships because of the greater costs of exploitation. Also, we explored individual differences in preferences, anticipating that participants with high social interaction anxiety would prefer more trustworthy looking faces. As expected, we found a preference for more trustworthy looking faces when participants considered a long-term *versus* a short-term relationship. Social interaction anxiety correlated positively with trustworthiness preferences, probably reflecting an avoidance response in anxious individuals, induced by untrustworthy cues. Collectively, these findings constitute novel evidence of the influence of individual differences in mate-choice relevant face preferences.

Trustworthiness; Attractiveness; Face preferences; Relationship context; Social interaction anxiety.

56 Public Significance Statement:

57 When participants were asked to manipulate opposite sex face images in
58 order to make them as attractive as possible, perceived trustworthiness was
59 enhanced. Highly trustworthy looking features were also preferred by participants
60 scoring high in social interaction anxiety and, particularly, when considering long-
61 term relationships.

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64 The attractive side of trustworthiness: Effects of relationship context and social
65 interaction anxiety on face preferences

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Introduction

68 Face attractiveness is believed to assume a core role in mating decisions. It
69 has been shown that face perception not only allows us to perceive information about
70 person's identity, and their mental, and emotional states (Todorov, Mende-Siedlecki,
71 & Dotsch, 2013), but also potentially about the quality of their eventual partners
72 (Little, Jones, & DeBruine, 2011). Regarding what is perceived as an attractive facial
73 shape, there is evidence that humans may feel attracted by different features
74 depending on the type of relationship context they are considering. Most studies
75 reporting this phenomenon of strategic pluralism (Gangestad & Simpson, 2000) have
76 focused on preferences regarding sexual dimorphic features and face symmetry.
77 Women tend to prefer more masculine, symmetrically faced men for a short-term
78 partner, supposedly prioritizing genetic quality and dominance (although see Nowak,
79 Pawłowski, Borkowska, Augustyniak, & Drulis-Kawa, 2018), as opposed to the
80 preference for more feminine male faces when considering a long-term relationship
81 (Little, Burt, Penton-Voak, & Perrett, 2001; Little & Jones, 2012; Jones et al., 2018;
82 Penton-Voak et al., 2003). Concerning men's preferences, although some studies
83 show no effects of relationship context when considering sexually dimorphic features
84 (Burriss, Welling, & Puts, 2011; Scott, Swami, Josephson, & Penton-Voak, 2008),
85 others do (Burriss et al., 2011; Carrito et al., 2016; Little, Jones, Feinberg, & Perrett,
86 2014). Some studies also claim that men place great weight on kindness and
87 honesty when considering a partner for a long-term relationship and prioritize other

88 characteristics, like physical attractiveness, for short-term relationships (Li, Bailey,
89 Kenrick, & Linsenmeier, 2002; Li & Kenrick, 2006; Regan, Levin, Sprecher,
90 Christopher, & Gate, 2000).

91 Another type of judgment that may also be important for attractiveness
92 perception and mate selection in humans is perceived trustworthiness. The
93 importance of trustworthiness relies on its impact on basic approach-avoidance
94 responses (Todorov, Pakrashi, & Oosterhof, 2009), used by individuals to decide
95 whether to approach or to avoid a stranger or, as the present work proposes, a new
96 partner. Trustworthiness judgments are made very rapidly when meeting someone
97 for the first time, with studies showing that 100 ms of stimulus exposure is sufficient
98 for such impression formation (Willis & Todorov, 2006).

99 Researchers have identified structural facial traits that contribute to a more
100 trustworthy appearance. These include high inner margins of the eyebrows,
101 pronounced cheekbones, wide chins, and shallow nose sellion. By contrast, faces
102 with low inner margins of the eyebrows, shallow cheekbones, thin chins, and deep
103 nose sellion tend to be perceived as less trustworthy (Todorov, Baron, & Oosterhof,
104 2008). Facial width also influences trustworthiness perceptions. Men with wider
105 faces, which is a masculine trait, are perceived as less trustworthy (Stirrat & Perrett,
106 2010). While structural features reveal the negative association between
107 trustworthiness and masculinity (Oosterhof & Todorov, 2008), expressive cues
108 highlight the strong relation between trustworthiness and emotion. Smiling faces are
109 perceived as more trustworthy (Krumhuber et al., 2007) while low trustworthy faces
110 evoke anger attributions (Winston, Strange, O'Doherty, & Dolan, 2002). Nonetheless,
111 some researchers claim that trustworthiness inferences are unlikely to be derived by
112 emotion alone (Bzdok et al., 2011).

113 The relationship between trustworthiness and attractiveness has been
114 analyzed in studies involving self-resembling faces. DeBruine (2005) used computer-
115 based techniques to create other-sex versions of participants' faces and asked them
116 to rate the attractiveness of those images. She found that, when participants
117 considered a short-term relationship, where the sexual appeal is the dominant
118 criterion, facial resemblance decreased attractiveness while increasing
119 trustworthiness. Given this, it is possible that cues to trustworthiness might be taken
120 into consideration for mate choice, depending on the relationship context considered
121 by participants. Inference of personality traits is proven to be very important in mate
122 choice for both sexes (Buss, 1989; Buss & Barnes, 1986), and trustworthiness may
123 be one of the desired features (Fletcher, Simpson, Thomas, & Giles, 1999). If that is
124 the case, trustworthiness traits would be expected to be attractive. There is evidence
125 for an association between attractiveness and trust since attractive faces are
126 perceived as more trustworthy (Wilson & Eckel, 2006).

127 Preferences for perceived trustworthiness in faces may vary according to
128 individual differences in observers, as such variation has been identified in
129 preferences for other trait preferences such as symmetry and sexual dimorphism
130 (Little, Burt, & Perrett, 2006; Little & Perrett, 2002; Holzleitner & Perrett, 2017;
131 Welling, DeBruine, Little, & Jones, 2009). One of the possible individual traits that
132 might influence attractiveness preferences is social interaction anxiety. Social
133 interaction anxiety refers to "distress when meeting and talking with other people, be
134 those people members of the opposite sex, strangers, or friends" (Mattick & Clarke,
135 1998, p. 457). Despite the lack of studies investigating the influence of social
136 interaction anxiety on face perception, some findings regarding related traits, such as
137 social anxiety and social phobia, may help us understand the impact of the former

138 individual trait on face preferences. Social anxiety seems to bias the perception of
139 certain emotional face expressions, making them look more threatening (Staugaard,
140 2010). On the other hand, social phobics seem to show increased sensitivity to threat
141 since, when asked to make a quick assessment of a neutral face slowly changing
142 into a negative expression, they identify angry faces at a lower intensity of change
143 compared to control participants (Joormann & Gotlib, 2006). Social phobia is
144 believed to be related to a dysregulation of the amygdala function (Amaral, 2002).
145 Patients with bilateral damage of the amygdala have also shown impairment in their
146 ability to assess whether a person looks trustworthy compared to a control group
147 (Adolphs, Tranel, & Damasio, 1998). Such findings, although referring to different
148 conditions of social interaction anxiety, indicate that people who experience distress
149 when interacting with others may be particularly attentive to trustworthiness cues in
150 social contexts.

151 The present study assessed whether attractiveness preferences for faces that
152 vary in perceived trustworthiness change when considering short- and long-term
153 relationship contexts and whether these preferences are influenced by social
154 interaction anxiety. Unfamiliar faces were presented to heterosexual participants of
155 both sexes, who were asked to consider them as potential mates and to adjust the
156 shape of each face until it looked the most attractive. The faces changed along a
157 perceived trustworthiness continuum. These attractiveness choices were made
158 considering partners for both a short-term and a long-term relationship. We predicted
159 that higher levels of perceived trustworthiness would be preferred for long-term
160 relationships compared to short-term ones. We expected this to occur both for male
161 and female participants since both sexes have been observed to place greater

162 importance on trustworthiness when considering long-term rather than short-term
163 relationships (Fletcher, Tither, O'Loughlin, Friesen, & Overall, 2004).

164 This study also explored the association between face preferences and
165 individual differences in social interaction anxiety. We hypothesized that those with
166 high social interaction anxiety would choose faces displaying cues of higher
167 perceived trustworthiness.

168

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Method

170 Participants

171 Sample size was estimated using G*Power 3.1.9.2 software, considering a
172 medium effect size ($\eta_p^2 = 0.08$), an alpha of .05 and a power of .8, resulting in an
173 ideal total sample size of 96 participants. We manage to recruit ninety-four volunteers
174 to participate in the experimental task, 46 women ($M_{age} = 21.37$, $SD = 2.29$) and 48
175 men ($M_{age} = 21.13$, $SD = 2.33$). Participants reported being exclusively or mainly
176 heterosexual (≤ 1 in a scale from 0 as “Exclusively heterosexual” to 6 as “Exclusively
177 homosexual”), and Caucasian. Participation did not involve any kind of compensation
178 (incentives were not provided).

179

180 Materials

181 Stimuli

182 Individually photographed faces (30 male and 30 female faces), taken under
183 standard pose and illumination conditions, and displaying a neutral facial expression,
184 were used. Each one of the 60 faces was delineated with 192 points (with x and y

185 coordinates) in order to delimit the face areas that would be transformed. Delineation
186 and face transformation were done using Psychomorph software (Tiddeman, Burt, &
187 Perrett, 2001). For both sexes, groups of three different facial photographs were
188 averaged together, to create 20 composite male faces and 20 composite female
189 faces. Averaging faces is possible by reshaping ('warping') each face into the
190 average shape and then blending images together digitally (Benson & Perrett, 1993).
191 Composite faces were used instead of the original individual faces since composites
192 are not recognizable as familiar individuals and assure lower levels of inter-individual
193 differences.

194 Two uniform face-shape masks, representing an average face of high perceived
195 trustworthiness and an average face of low perceived trustworthiness, were used to
196 manipulate the shape of the composite faces. Each one of the masks was an average
197 of 10 Caucasian faces developed by Todorov et al. (2008) using FaceGen software
198 (www.facegen.com), previously rated as high or low in perceived trustworthiness (for
199 more details, see Dzhelyova, Perrett, & Jentsch, 2012). The manipulation of the
200 composite faces was based on the shape difference between those two endpoint
201 shape masks, resulting in a set of 11 images for each face, ranging from -50%
202 trustworthiness to +50% trustworthiness, with the middle image being the original
203 composite face, as exemplified in Figure 1. Finally, the hair, neck, ears, and
204 background were occluded with an oval black mask.

205



206

207 Figure 1. Example of the trustworthiness transformation. The image on the left
208 represents the most untrustworthy version (-50% transformation), the one in the
209 middle is the original composite face, and the face on the right represents the most
210 trustworthy version (+50% transformation).

211

212 Questionnaires

213 Participants were asked to complete a demographics questionnaire including
214 information about age, sex, ethnicity, and sexual orientation. Participants also
215 responded to the Portuguese version of the Social Interaction Anxiety Scale (SIAS)
216 (Mattick & Clarke, 1998; Pinto-Gouveia & Salvador, 2001). The SIAS assesses
217 anxiety in interpersonal interactions. This questionnaire has good levels of internal
218 consistency and adequate construct validity (Brown et al., 1997). We obtained a
219 Cronbach's α of .90 for our sample and a mean sum value of 29.35 ($SD = 11.7$,
220 range 6–55).

221

222 Procedure

223 All aspects of the study were performed in accordance with the Declaration of
224 Helsinki for experimentation with human subjects. The study was part of a project
225 that was approved by the Scientific Council of the University of Aveiro, which
226 assesses its ethical, formal, and scientific aspects. Participants started by signing an
227 informed consent form, after which they were asked to complete a socio-
228 demographic questionnaire followed by the SIAS. After concluding the
229 questionnaires, participants performed a face manipulation task, where they were
230 told to alter each of the faces until they found the most attractive face within the
231 range available. The faces presented were of the opposite sex to the participant. To
232 be able to visualize the face changing, participants were required to move the mouse
233 horizontally across the image and background, which resulted in a gradual morphing
234 effect with 11 different frames. The chosen face was selected by pressing the left key
235 of the mouse. The starting frame was randomized, and there was no time limit for the
236 task. The 20 composite faces were presented one at a time. Underlying changes in
237 apparent trustworthiness level were not mentioned explicitly to the participants.
238 Participants were told that half of the faces should be considered as possible mates
239 for a short-term relationship, and the other half should be considered as possible
240 long-term mates. For the different conditions, the instruction was, respectively,
241 “Please alter the face until you think it is the closest to the appearance you would find
242 attractive for a partner in a short-term (or long-term) relationship”. Short- and long-
243 term relationship contexts were defined and described to the participants as in
244 previous research (Penton-Voak et al., 2003). The sets of 10 faces associated with
245 each relationship context were counterbalanced between participants. The order in
246 which participants did the task in terms of relationship context (short- or long-term)
247 and the order of the faces presented within each set were randomized.

248

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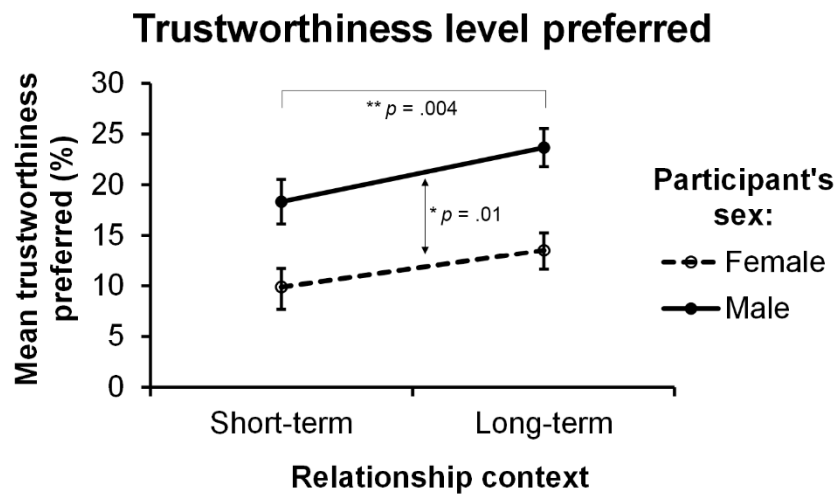
Results

250 Overall preferences and effects of sex of participant and relationship context

251 For each participant, the mean degree of perceived trustworthiness considered
252 to be maximally attractive was calculated. Distributions were normal (Kolmogorov-
253 Smirnov tests, $p > .11$), and homogeneity of variances was assumed (Levene's tests,
254 $p > .12$). One sample t-tests revealed that preferences for more trustworthy looking
255 faces were greater than chance (i.e. 0%, which would mean a choice not different from
256 the original face) for both short-term [$t(93) = 6.88, p < .001, d = 1.419$, Common
257 Language (CL) effect size = .84] and long-term relationship contexts [$t(93) = 9.97, p <$
258 $.001, d = 2.056$, CL effect size = .93].

259 Perceived trustworthiness preferences were examined via a mixed ANOVA
260 [dependent variable: trustworthiness level preferred; within-subjects factor:
261 relationship context (short- and long-term); between-subjects factor: sex of participant].
262 This analysis yielded a significant main effect of relationship context, $F(1, 92) = 8.62$,
263 $p = .004, \eta_p^2 = 0.086$, with higher levels of perceived trustworthiness being more
264 attractive for long-term relationships ($M = + 18.59\%$, $SE = 1.81$) than short-term
265 relationships ($M = + 14.10\%$, $SE = 2.03$). A significant main effect of sex of participant
266 also emerged, $F(1, 92) = 6.96, p = .01, \eta_p^2 = 0.07$, such that men selected a higher
267 level of perceived trustworthiness in opposite sex faces as more attractive ($M = +$
268 21.00% , $SE = 2.47$) compared to women, who preferred comparatively lower levels of
269 perceived trustworthiness ($M = + 11.70\%$, $SE = 2.52$). The interaction between
270 relationship context and sex of participants was not significant, $F(1, 92) = .30, p = .58$,
271 $\eta_p^2 = 0.003$ (see Figure 2).

272



273

274 Figure 2. Mean perceived trustworthiness level preferred as a function of
 275 relationship context (short- or long-term) and sex of the participant. Error bars show
 276 standard errors of the mean.

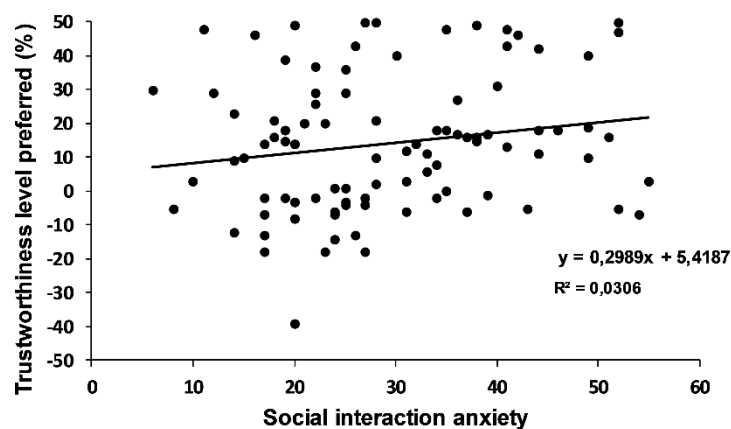
277

278 Social interaction anxiety

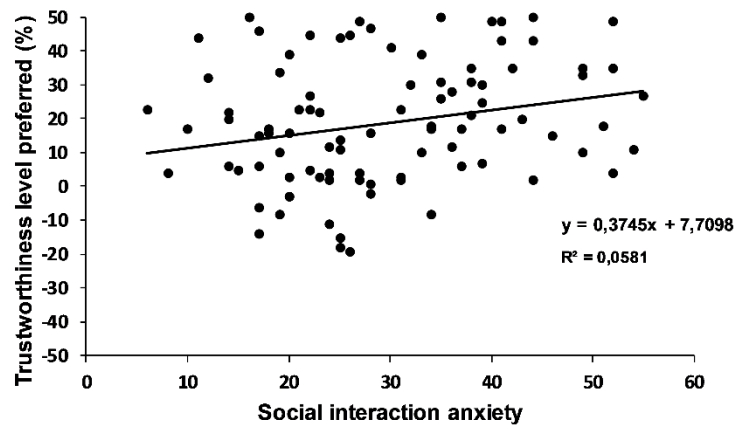
279 Sex differences in social interaction anxiety were explored through a t-test
 280 analysis. No differences in the level of social interaction anxiety were found between
 281 male ($M = 28.75$, $SE = 11.32$) and female participants ($M = 29.98$, $SE = 12.20$), $t(92)$
 282 $= 0.51$, $p = .614$, $d = .10$, CL effect size = 0.53. The relation between preferred level of
 283 apparent trustworthiness and individual differences in social interaction anxiety was
 284 examined through ANCOVA analysis [dependent variable: trustworthiness level
 285 preferred; within-subjects factor: relationship context (short- and long-term); between-
 286 subjects factor: sex of participant; covariate: social interaction anxiety]. Social
 287 interaction anxiety values were standardized by being converted to z-scores. This
 288 analysis revealed a significant effect of relationship context on trustworthiness

289 preferences, $F(1, 91) = 8.56$, $p = .004$, $\eta_p^2 = 0.086$, with higher levels of perceived
290 trustworthiness being again more attractive for long-term relationships ($M = 18.59\%$,
291 $SE = 1.76$) than short-term relationships ($M = 14.10\%$, $SE = 2.00$). There was also a
292 significant effect of sex of participant, $F(1, 91) = 8.02$, $p = .006$, $\eta_p^2 = 0.081$, with male
293 participants ($M = 21.22\%$, $SE = 2.41$) preferring higher levels of trustworthiness in
294 opposite sex faces compared to female participants ($M = 11.47\%$, $SE = 2.46$). Also,
295 there was a significant effect of the covariate (social interaction anxiety), $F(1, 91) =$
296 5.90 , $p = .017$, $\eta_p^2 = 0.061$.

297 Although the interaction effect between relationship context and social
298 interaction anxiety was not significant, $F(1, 91) = 0.36$, $p = .548$, $\eta_p^2 = 0.004$, parameter
299 estimation revealed a significant effect of social interaction anxiety on long-term
300 relationship context, $t(91) = 2.64$, $p = .01$, $\eta_p^2 = 0.071$, but not on short-term
301 relationship context, $t(91) = 1.86$, $p = .067$, $\eta_p^2 = 0.036$. Figures 3 and 4 represent the
302 relationship between the social interaction anxiety levels and the trustworthiness
303 preferences when considering both short- (Fig. 3) and long-term (Fig. 4) relationship
304 contexts.



306 Figure 3. The relation between social interaction anxiety (unstandardized values) and
307 trustworthiness preferences when considering a short-term relationship context.



308

309 Figure 4. The relation between social interaction anxiety (unstandardized
310 values) and trustworthiness preferences when considering a long-term relationship
311 context.

312

313

Discussion

314 The results of this study provide a broad understanding of male and female
315 preferences for face cues of apparent trustworthiness in a mating context.

316 Participants seemed to show different preferences for faces that varied in their
317 perceived trustworthiness level depending on the relationship context involved.

318 Specifically, participants preferred more trustworthy looking faces when choosing a
319 partner for long-term relationships, compared to short-term relationships. Similarly to

320 previous research (Little, Jones, Penton-Voak, Burt, & Perrett, 2002; Jones et al.,
321 2018), this result suggests the presence of different mating strategies which are

322 dependent on relationship goal. Previous research has suggested that signs of
323 genetic fitness and/or dominance become more attractive for short-term

324 relationships, whereas other features often related to trustworthiness become more
325 attractive for long-term relationships. Previous studies have also reported that both
326 women and men place greater weight on “good-genes” cues when considering a
327 short-term relationship and tend to prioritize other traits for long-term relationships
328 (Carrito et al., 2016; Fletcher et al., 1999; Little, Cohen, Jones, & Belsky, 2007).
329 When choosing a partner for a long-term relationship, a preference for more
330 trustworthy partners who are committed to the relationship and prone to take care of
331 living offspring might be adaptive (Andersson, 1994).

332 Moreover, a statistically significant effect of sex of participant emerged from
333 the analyses, showing that women preferred lower levels of perceived
334 trustworthiness in opposite-sex faces compared to men. It is possible that female
335 participants preferred comparatively lower levels of facial trustworthiness because
336 they were trying to retain some benefits from slightly masculinized males. According
337 to Oosterhof and Todorov (2008), masculinity is inversely proportional to perceived
338 trustworthiness. Therefore women searching for signs of genetic fitness (Foo,
339 Nakagawa, Rhodes, & Simmons, 2016; although see Nowak et al., 2018; Phalane,
340 Tribe, Steel, Cholo, & Coetzee, 2017) or behavioral benefits in men’s faces (Puts,
341 2010) may have tolerated lower levels of trustworthiness. On the other hand, since
342 trustworthiness goes along with femininity in female faces (Oosterhof & Todorov,
343 2008), it is possible that men preferred more trustworthy faces because they were
344 not forced to make any trade-off. Such conclusions should perhaps be made with
345 caution because face stimuli were different for men and women given that each
346 manipulated opposite-sex faces.

347 Subsequent analyses explored the effects of social interaction anxiety on
348 facial preferences. It appears that trustworthiness preferences increase alongside the

349 social interaction anxiety of the individuals, regardless of their sex or relationship
350 context goals. This result was expected since socially anxious individuals date less
351 and have fewer sexual relationships (Alden & Taylor, 2004) and may search for
352 someone more trustworthy who will not trigger their fears. This hypothesis is
353 supported by evidence that highly socially anxious individuals show stronger
354 avoidance tendencies towards angry faces (Heuer, Rinck, & Becker, 2007; Roelofs et
355 al., 2010). In fact, social anxiety was found to be related to impaired relationship
356 functioning (Hart, Turk, Heimberg, & Liebowitz, 1999).

357 The attentional bias theory proposes that socially anxious individuals have a
358 higher propensity to be attentive to threatening cues in the environment (Staugaard,
359 2010). If socially anxious individuals are extra vigilant to threats and are
360 characterized by a negatively biased processing of social information (Cooney, Atlas,
361 Joormann, Eugène, & Gotlib, 2006), they are also likely to be more sensitive to cues
362 of untrustworthiness and may thus prefer a face that is clearly trustworthy looking
363 when considering someone for a long-term relationship, which is in line with this
364 study's findings.

365 One limitation of the current study is related to the lack of studies investigating
366 the influence of social interaction anxiety on face preferences and face perception in
367 general. Taking this into account, most of the theoretical background mentioned here
368 concerns studies on social anxiety and social phobia in general, although the authors
369 are aware of the difference between such distinct concepts. Future studies should
370 explore specifically how social interaction anxiety influences the way we perceive
371 faces of others as it clearly impacts human interactions.

372 To the best of our knowledge, this is the first study to acknowledge the
373 influence of relationship context on attractiveness preferences for perceived
374 trustworthy face traits. Also, the possible influence of individual differences, such as
375 social interaction anxiety, on preferences for perceived face trustworthiness has not
376 been considered before. The present results have shown that trustworthy looking
377 facial features are favored by those with high levels of social interaction anxiety.
378 Overall, this study provides further evidence that strategies underlying mate choice
379 depend partially on individual characteristics and highlights the importance of
380 perceived trustworthiness in attraction.

381

382

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390 References

- 391 Adolphs, R., Tranel, D., & Damasio, A. R. (1998). The human amygdala in social
392 judgment. *Nature*, 393(6684), 470-474. <https://doi.org/10.1038/30982>
- 393 Alden, L. E., & Taylor, C. T. (2004). Interpersonal processes in social phobia. *Clinical*
394 *Psychology Review*, 24(7), 857-882.
395 <https://doi.org/10.1016/j.cpr.2004.07.006>
- 396 Amaral, D. G. (2002). The primate amygdala and the neurobiology of social behavior:
397 implications for understanding social anxiety. *Biological Psychiatry*, 51(1), 11-
398 17. [https://doi.org/10.1016/S0006-3223\(01\)01307-5](https://doi.org/10.1016/S0006-3223(01)01307-5)
- 399 Andersson, M. B. (1994). *Sexual selection*: Princeton University Press.
- 400 Benson, P. J., & Perrett, D. I. (1993). Extracting prototypical facial images from
401 exemplars. *Perception*, 22(3), 257-262. <https://doi.org/10.1068/p220257>
- 402 Brown, E. J., Turovsky, J., Heimberg, R. G., Juster, H. R., Brown, T. A., & Barlow, D.
403 H. (1997). Validation of the Social Interaction Anxiety Scale and the Social
404 Phobia Scale across the anxiety disorders. *Psychological Assessment*, 9(1),
405 21-27. <https://doi.org/10.1037/1040-3590.9.1.21>.
- 406 Burriss, R. P., Welling, L. L. M., & Puts, D. A. (2011). Men's attractiveness predicts
407 their preference for female facial femininity when judging for short-term, but
408 not long-term, partners. *Personality and Individual Differences*, 50(5), 542-
409 546. <https://doi.org/10.1016/j.paid.2010.11.022>
- 410 Buss, D. M. (1989). Sex differences in human mate preferences: Evolutionary
411 hypotheses tested in 37 cultures. *Behavioral and Brain Sciences*, 12(1), 1-49.
412 <https://doi.org/10.1017/S0140525X00023992>

- 413 Buss, D. M., & Barnes, M. (1986). Preferences in human mate selection. *Journal of*
414 *Personality and Social Psychology*, 50(3), 559-570.
415 <https://doi.org/10.1037/0022-3514.50.3.559>
- 416 Bzdok, D., Langner, R., Caspers, S., Kurth, F., Habel, U., Zilles, K., . . . Eickhoff, S.
417 B. (2011). ALE meta-analysis on facial judgments of trustworthiness and
418 attractiveness. *Brain Structure and Function*, 215(3), 209-223.
419 <https://doi.org/10.1007/s00429-010-0287-4>
- 420 Carrito, M. L., Santos, I. M., Lefevre, C. E., Whitehead, R. D., Silva, C. F., & Perrett,
421 D. I. (2016). The role of sexually dimorphic skin colour and shape in
422 attractiveness of male faces. *Evolution and Human Behavior*, 37(2), 125-333.
423 <https://doi.org/10.1016/j.evolhumbehav.2015.09.006>
- 424 Cooney, R. E., Atlas, L. Y., Joormann, J., Eugène, F., & Gotlib, I. H. (2006).
425 Amygdala activation in the processing of neutral faces in social anxiety
426 disorder: Is neutral really neutral? *Psychiatry Research: Neuroimaging*,
427 148(1), 55-59. <https://doi.org/10.1016/j.psychresns.2006.05.003>
- 428 DeBruine, L. M. (2005). Trustworthy but not lust-worthy: Context-specific effects of
429 facial resemblance. *Proceedings of the Royal Society of London B: Biological*
430 *Sciences*, 272(1566), 919-922. <https://doi.org/10.1098/rspb.2004.3003>
- 431 Dzhelyova, M., Perrett, D. I., & Jentsch, I. (2012). Temporal dynamics of
432 trustworthiness perception. *Brain Research*, 1435(0), 81-90.
433 <https://doi.org/10.1016/j.brainres.2011.11.043>
- 434 Fletcher, G. J. O., Simpson, J. A., Thomas, G., & Giles, L. (1999). Ideals in intimate
435 relationships. *Journal of Personality and Social Psychology*, 76(1), 72-89.
436 <https://doi.org/10.1037/0022-3514.76.1.72>

- 437 Fletcher, G. J. O., Tither, J. M., O'Loughlin, C., Friesen, M., & Overall, N. (2004).
438 Warm and homely or cold and beautiful? Sex differences in trading off traits
439 in mate selection. *Personality & Social Psychology Bulletin*, 30, 659–672.
440 <https://doi.org/10.1177/0146167203262847>.
- 441 Foo, Y. Z., Nakagawa, S., Rhodes, G., & Simmons, L. W. (2016). The effects of sex
442 hormones on immune function: A meta-analysis. *Biological Reviews*, 0.
443 <https://doi.org/10.1111/brv.12243>
- 444 Gangestad, S. W., & Simpson, J. A. (2000). The evolution of human mating: Trade-
445 offs and strategic pluralism. *Behavioral and Brain Sciences*, 23(04), 573-587.
446 <https://doi.org/10.1017/S0140525X0000337X>
- 447 Hart, T. A., Turk, C. L., Heimberg, R. G., & Liebowitz, M. R. (1999). Relation of
448 marital status to social phobia severity. *Depression and Anxiety*, 10(1), 28-
449 32. [https://doi.org/10.1002/\(SICI\)1520-6394\(1999\)10:1<28::AID-
450 DA5>3.0.CO;2-I](https://doi.org/10.1002/(SICI)1520-6394(1999)10:1<28::AID-DA5>3.0.CO;2-I)
- 451 Heuer, K., Rinck, M., & Becker, E. S. (2007). Avoidance of emotional facial
452 expressions in social anxiety: The Approach–Avoidance Task. *Behaviour
453 Research and Therapy*, 45(12), 2990-3001.
454 <https://doi.org/10.1016/j.brat.2007.08.010>
- 455 Holzleitner, I. J., & Perrett, D. I. (2017). Women's preferences for men's facial
456 masculinity: Trade-off accounts revisited. *Adaptive Human Behavior and
457 Physiology*, 3(4), 304-320. <https://doi.org/10.1007/s40750-017-0070-3>
- 458 Jones, B. C., Hahn, A. C., Fisher, C. I., Wang, H., Kandrik, M., Han, C., ... DeBruine,
459 L. M. (2018). No compelling evidence that preferences for facial masculinity
460 track changes in women's hormonal status. *Psychological Science*, 29(6),
461 996–1005. <https://doi.org/10.1177/0956797618760197>

- 462 Joormann, J., & Gotlib, I. H. (2006). Is this happiness I see? Biases in the
463 identification of emotional facial expressions in depression and social phobia.
464 *Journal of Abnormal Psychology, 115*(4), 705. [https://doi.org/10.1037/0021-](https://doi.org/10.1037/0021-843X.115.4.705)
465 [843X.115.4.705](https://doi.org/10.1037/0021-843X.115.4.705)
- 466 Krumhuber, E., Manstead, A. S. R., Cosker, D., Marshall, D., Rosin, P. L., & Kappas,
467 A. (2007). Facial dynamics as indicators of trustworthiness and cooperative
468 behavior. *Emotion, 7*(4), 730-735. <https://doi.org/10.1037/1528-3542.7.4.730>.
- 469 Li, N. P., Bailey, J. M., Kenrick, D. T., & Linsenmeier, J. A. W. (2002). The
470 necessities and luxuries of mate preferences: testing the tradeoffs. *Journal of*
471 *Personality and Social Psychology, 82*(6), 947. [https://doi.org/10.1037/0022-](https://doi.org/10.1037/0022-3514.82.6.947)
472 [3514.82.6.947](https://doi.org/10.1037/0022-3514.82.6.947)
- 473 Li, N. P., & Kenrick, D. T. (2006). Sex similarities and differences in preferences for
474 short-term mates: what, whether, and why. *Journal of Personality and Social*
475 *Psychology, 90*(3), 468. <https://doi.org/10.1037/0022-3514.90.3.468>
- 476 Little, A. C., Burt, D. M., Penton-Voak, I. S., & Perrett, D. I. (2001). Self-perceived
477 attractiveness influences human female preferences for sexual dimorphism
478 and symmetry in male faces. *Proceedings of the Royal Society of London.*
479 *Series B: Biological Sciences, 268*(1462), 39-44.
480 <https://doi.org/10.1098/rspb.2000.1327>
- 481 Little, A. C., Burt, D. M., & Perrett, D. I. (2006). What is good is beautiful: Face
482 preference reflects desired personality. *Personality and Individual*
483 *Differences, 41*(6), 1107-1118. <https://doi.org/10.1016/j.paid.2006.04.015>
- 484 Little, A. C., Cohen, D. L., Jones, B. C., & Belsky, J. (2007). Human preferences for
485 facial masculinity change with relationship type and environmental

- 486 harshness. *Behavioral Ecology and Sociobiology*, 61(6), 967-973.
487 <https://doi.org/10.1007/s00265-006-0325-7>
- 488 Little, A. C., & Jones, B. C. (2012). Variation in facial masculinity and symmetry
489 preferences across the menstrual cycle is moderated by relationship context.
490 *Psychoneuroendocrinology*, 37(7), 999-1008.
491 <https://doi.org/10.1016/j.psyneuen.2011.11.007>
- 492 Little, A. C., Jones, B. C., & DeBruine, L. M. (2011). Facial attractiveness:
493 Evolutionary based research. *Philosophical Transactions of the Royal
494 Society B: Biological Sciences*, 366(1571), 1638-1659.
495 <https://doi.org/10.1098/rstb.2010.0404>
- 496 Little, A. C., Jones, B. C., Feinberg, D. R., & Perrett, D. I. (2014). Men's strategic
497 preferences for femininity in female faces. *British Journal of Psychology*,
498 105(3), 364-381. <https://doi.org/10.1111/bjop.12043>
- 499 Little, A. C., Jones, B. C., Penton-Voak, I. S., Burt, D. M., & Perrett, D. I. (2002).
500 Partnership status and the temporal context of relationships influence human
501 female preferences for sexual dimorphism in male face shape. *Proceedings
502 of the Royal Society of London. Series B: Biological Sciences*, 269(1496),
503 1095-1100. <https://doi.org/10.1098/rspb.2002.1984>
- 504 Little, A. C., & Perrett, D. I. (2002). Putting beauty back in the eye of the beholder.
505 *The Psychologist*, 15(1), 28-32.
- 506 Mattick, R. P., & Clarke, J. C. (1998). Development and validation of measures of
507 social phobia scrutiny fear and social interaction anxiety. *Behaviour
508 Research and Therapy*, 36(4), 455-470. [https://doi.org/10.1016/S0005-
509 7967\(97\)10031-6](https://doi.org/10.1016/S0005-7967(97)10031-6)

- 510 Nowak, J., Pawłowski, B., Borkowska, B., Augustyniak, D., & Drulis-Kawa, Z. (2018).
511 No evidence for the immunocompetence handicap hypothesis in male
512 humans. *Scientific Reports*, 8(1), 7392. [https://doi.org/10.1038/s41598-018-](https://doi.org/10.1038/s41598-018-25694-0)
513 [25694-0](https://doi.org/10.1038/s41598-018-25694-0)
- 514 Oosterhof, N. N., & Todorov, A. (2008). The functional basis of face evaluation.
515 *Proceedings of the National Academy of Sciences*, 105(32), 11087-11092.
516 <https://doi.org/10.1073/pnas.0805664105>
- 517 Phalane, K. G., Tribe, C., Steel, H. C., Cholo, M. C., & Coetzee, V. (2017). Facial
518 appearance reveals immunity in African men. *Scientific Reports*, 7, 7443.
519 <https://doi.org/10.1038/s41598-017-08015-9>
- 520 Penton-Voak, I. S., Little, A. C., Jones, B. C., Burt, D. M., Tiddeman, B. P., & Perrett,
521 D. I. (2003). Female condition influences preferences for sexual dimorphism
522 in faces of male humans (*Homo sapiens*). *Journal of Comparative*
523 *Psychology*, 117(3), 264. <https://doi.org/10.1037/0735-7036.117.3.264>
- 524 Pinto-Gouveia, J., & Salvador, M. C. (2001). *The social interaction anxiety scale and*
525 *the social phobia scale in the Portuguese population*. Poster presented at the
526 XXXI Congress of the European Association of the Behavioural and
527 Cognitive therapies, Istanbul.
- 528 Puts, D. A. (2010). Beauty and the beast: mechanisms of sexual selection in
529 humans. *Evolution and Human Behavior*, 31(3), 157-175.
530 <https://doi.org/10.1016/j.evolhumbehav.2010.02.005>
- 531 Regan, P. C., Levin, L., Sprecher, S., Christopher, F. S., & Gate, R. (2000). Partner
532 preferences: What characteristics do men and women desire in their short-
533 term sexual and long-term romantic partners? *Journal of Psychology &*
534 *Human Sexuality*, 12(3), 1-21. https://doi.org/10.1300/J056v12n03_01

- 535 Roelofs, K., Putman, P., Schouten, S., Lange, W., Volman, I., & Rinck, M. (2010).
536 Gaze direction differentially affects avoidance tendencies to happy and angry
537 faces in socially anxious individuals. *Behaviour Research and Therapy*,
538 48(4), 290-294. <https://doi.org/10.1016/j.brat.2009.11.008>
- 539 Scott, I., Swami, V., Josephson, S. C., & Penton-Voak, I. S. (2008). Context-
540 dependent preferences for facial dimorphism in a rural Malaysian population.
541 *Evolution and Human Behavior*, 29(4), 289-296.
542 <https://doi.org/10.1016/j.evolhumbehav.2008.02.004>
- 543 Staugaard, S. R. (2010). Threatening faces and social anxiety: A literature review.
544 *Clinical Psychology Review*, 30(6), 669-690.
545 <https://doi.org/10.1016/j.cpr.2010.05.001>
- 546 Stirrat, M., & Perrett, D. I. (2010). Valid facial cues to cooperation and trust: Male
547 facial width and trustworthiness. *Psychological science*, 21(3), 349-354.
548 <https://doi.org/10.1177/0956797610362647>
- 549 Tiddeman, B., Burt, M., & Perrett, D. (2001). Prototyping and transforming facial
550 textures for perception research. *Computer Graphics and Applications, IEEE*,
551 21(5), 42-50. <https://doi.org/10.1109/38.946630>
- 552 Todorov, A., Baron, S. G., & Oosterhof, N. N. (2008). Evaluating face
553 trustworthiness: A model based approach. *Social Cognitive and Affective*
554 *Neuroscience*, 3(2), 119-127. <https://doi.org/10.1093/scan/nsn009>
- 555 Todorov, A., Mende-Siedlecki, P., & Dotsch, R. (2013). Social judgments from
556 faces. *Current opinion in neurobiology*, 23(3), 373-380.
557 <https://doi.org/10.1016/j.conb.2012.12.010>

- 558 Todorov, A., Pakrashi, M., & Oosterhof, N. N. (2009). Evaluating faces on
559 trustworthiness after minimal time exposure. *Social Cognition, 27*(6), 813-
560 833. <https://doi.org/10.1521/soco.2009.27.6.813>
- 561 Welling, L. L. M., DeBruine, L. M., Little, A. C., & Jones, B. C. (2009). Extraversion
562 predicts individual differences in women's face preferences. *Personality and*
563 *Individual Differences, 47*(8), 996-998.
564 <https://doi.org/10.1016/j.paid.2009.06.030>
- 565 Willis, J., & Todorov, A. (2006). First impressions: Making up your mind after a 100-
566 ms exposure to a face. *Psychological Science, 17*(7), 592-598.
567 <https://doi.org/10.1111/j.1467-9280.2006.01750.x>
- 568 Wilson, R. K., & Eckel, C. C. (2006). Judging a book by its cover: Beauty and
569 expectations in the trust game. *Political Research Quarterly, 59*(2), 189-202.
570 <https://doi.org/10.1177/106591290605900202>
- 571 Winston, J. S., Strange, B. A., O'Doherty, J., & Dolan, R. J. (2002). Automatic and
572 intentional brain responses during evaluation of trustworthiness of faces.
573 *Nature Neuroscience, 5*(3), 277-283. <https://doi.org/10.1038/nn816>