

This is a pre-copyedited, author-produced PDF of an article accepted for publication in Behavioral Ecology following peer review. The version of record Watkins, C.D., Jones, B.C. 2012. Priming men with different contest outcomes modulates their dominance perceptions. *Behavioral Ecology*. 23(3): pp.539-543. is available online at: Oxford University Press, <http://dx.doi.org/10.1093/beheco/arr221>

1 **Priming men with different contest outcomes modulates their dominance**
2 **perceptions**

3

4 Christopher D Watkins & Benedict C Jones

5

6 Face Research Laboratory, School of Psychology,

7 University of Aberdeen, Aberdeen, Scotland, UK.

8

9

10

11

12

13 **Corresponding author**

14 Christopher Watkins, Face Research Laboratory,

15 University of Aberdeen, Scotland, UK.

16 Tel: +44 (0)1224 273933

17 Fax: +44 (0)1224 273426

18 Email: r01cdw9@abdn.ac.uk

19

20 **Priming men with different contest outcomes modulates their dominance**
21 **perceptions**

22

23 **Abstract**

24 It has recently been proposed that dominance perceptions in men function, at least
25 in part, to reduce the potential costs of within-sex competition for resources and that
26 sensitivity to cues of men's dominance is greatest among men who would incur the
27 largest costs if they engaged in competition with rivals indiscriminately (i.e., low-
28 dominance men). Consistent with these proposals, we found that men randomly
29 allocated to priming conditions in which they imagined losing confrontations with
30 other men subsequently demonstrated greater sensitivity to dominance cues when
31 assessing the dominance of men's faces than did men randomly allocated to priming
32 conditions in which they imagined winning confrontations. No equivalent effect
33 occurred for perceptions of men's trustworthiness, suggesting that the priming effect
34 observed for dominance judgments may be somewhat specific to competition-related
35 perceptions. Collectively, these findings suggest that men's perceptions of other
36 men's dominance are facultative, changing in response to contextual cues, such as
37 the outcomes of recent confrontations. Such responses could play a critical role in
38 calibrating men's dominance sensitivity according to their recent experiences and
39 are consistent with findings from experiments with other species in which the
40 outcome of prior confrontations modulated competition-related behaviors.

41

42 **Keywords:** dominance, within-sex competition, aggression, fighting experience

43 **Introduction**

44 Dominance perceptions are critical for social behavior in humans and are
45 fundamental to how we evaluate other people (Keating & Bai, 1986; Oosterhof &
46 Todorov, 2008; Thomsen et al., 2011). Perceptions of others' dominance are made
47 very rapidly (Carre et al., 2009), allow the perceiver to gauge a rival's potential to
48 acquire and retain resources (Sell et al., 2009), and may function, at least in part, to
49 minimize the potential costs of within-sex competition (Puts, 2010). Men's facial
50 masculinity is positively correlated with both indices of their actual dominance, such
51 as objective measures of physical strength (Fink et al. 2007), physical condition
52 (Gangestad et al., 2010), and social status (Mueller & Mazur, 1996), and indices of
53 their perceived dominance (e.g., Boothroyd et al., 2007; Perrett et al., 1998; see also
54 Keating et al., 1981; Senior et al., 1999a, 1999b). Collectively, these findings
55 suggest that masculine facial characteristics play a key role in signaling men's
56 dominance (reviewed in Puts, 2010). Indeed, masculine physical traits are correlated
57 with male dominance rank (e.g., Marty et al., 2009; Pelletier & Festa-Bianchet,
58 2006), fighting ability (e.g., Bergeron et al., 2010), physical strength (e.g., Malo et al.,
59 2009), and reproductive success (e.g., Preston et al., 2003) in a wide range of non-
60 human species, suggesting that sexually dimorphic physical characteristics play an
61 important role in within-sex competition in many different species (see e.g., Emlen,
62 2008 and Santos et al., 2011 for reviews).

63

64 Recent studies have investigated individual differences in the extent to which men
65 perceive masculinized versions of men's faces to be more dominant than feminized
66 versions (i.e., individual differences in their dominance sensitivity), finding that low-
67 dominance men are more sensitive to dominance cues in men's faces than are high-

68 dominance men (Watkins et al., 2010a, 2010b; but see also Wolff & Puts, 2010).
69 This greater dominance sensitivity among low-dominance men may occur because
70 such individuals are likely to be at greater risk of incurring substantial costs from
71 within-sex competition with dominant individuals (Watkins et al., 2010a; see also Hsu
72 et al. 2006). While this prior research investigated differences among men in their
73 dominance sensitivity, men's dominance sensitivity could also be facultative and
74 change within men in response to contextual cues, such as recent experiences of
75 winning or losing confrontations. Indeed, changes in dominance sensitivity in
76 response to the outcomes of recent confrontations could be important for men to
77 calibrate their dominance sensitivity according to their experiences in new
78 environments. Consistent with this proposal, researchers have previously
79 emphasized that the outcomes of recent confrontations are likely to play a critical
80 role in shaping men's desire to seek or avoid further competition (e.g., Mehta &
81 Josephs, 2006). Indeed, in many non-human species, losers of recent confrontations
82 are less likely to initiate further aggressive confrontations than are winners, while
83 winners of recent confrontations are more likely to escalate future confrontations to
84 aggressive conflict (e.g., Hsu & Wolf, 2001; Hsu et al., 2006). Given the potential
85 importance of aggressive conflict and dominance perceptions for resource
86 acquisition and resource holding in many human societies (Sell et al., 2009), similar
87 effects of the outcomes of recent confrontations may be evident in men's facultative
88 responses when assessing other men's dominance.

89

90 If men's dominance perceptions are influenced by the outcomes of their recent
91 confrontations, it may be possible to prime men's sensitivity to dominance cues in
92 men's faces simply by having them imagine either losing or winning a confrontation.

93 Indeed, many previous studies, including studies of facultative responses to facial
94 cues, have demonstrated priming effects by asking participants to imagine
95 themselves in different scenarios (e.g., Chen et al., 1996; Little et al., 2007, Maner et
96 al., 2009; Utz et al., 2004). Thus, we first investigated men's perceptions of the
97 dominance of masculinized versus feminized versions of men's faces when
98 participants were randomly allocated to conditions in which they were instructed to
99 imagine themselves either winning or losing a confrontation. Given findings from
100 prior correlational work on relationships between men's own dominance and their
101 dominance sensitivity, which have observed negative relationships between these
102 variables (Watkins et al., 2010a, 2010b), we predicted that men would be more
103 sensitive to dominance cues in men's faces after imagining losing a confrontation
104 than after imagining winning a confrontation.

105

106 Greater dominance sensitivity among low-dominance men has been observed when
107 men's own dominance was estimated from their height (Watkins et al., 2010a), which
108 is ostensibly an index of physical dominance (see Stulp et al., 2011 for a recent
109 review). In subsequent studies (Watkins et al., 2010b), similar results were also
110 observed when men's own dominance was assessed using the dominance scale of
111 the International Personality Items Pool (Goldberg, 1999), which, given the nature of
112 the questionnaire items (e.g., "I want to control the conversation"), is ostensibly a
113 measure of social dominance (Havlicek et al., 2005). Less *physically* dominant men
114 may incur more substantial costs if they are relatively insensitive to dominance cues
115 in potential rivals because they are less likely to be physically equipped to offset the
116 costs of indiscriminate engagement in aggressive conflict (Watkins et al., 2010a; see
117 also Hsu et al., 2006). Less *socially* dominant men could also incur more substantial

118 costs if they are relatively insensitive to dominance cues in potential rivals, however,
119 if social and physical dominance are correlated in men or if socially dominant men's
120 social status affords them greater protection from physically dominant rivals, as
121 appears to be case in both young men and non-human primates (e.g., Decker &
122 Curry, 2000; Wilson et al., 2001; Wrangham & Wilson, 2004). In addition to testing
123 for evidence of facultative responses to dominance cues, we explored these two
124 subtly different explanations for the possible effect of men's own social dominance
125 that was observed in prior work (Watkins et al., 2010b) by comparing the effects of
126 imagining a physical confrontation (a physical fight) or a non-physical confrontation
127 (a verbal argument) on men's dominance sensitivity. We compared the effects of
128 confrontation outcome on dominance sensitivity in these two conditions because,
129 although the costs of losing a physical confrontation (e.g., injury) may directly
130 influence men's ability to compete for resources, losing a verbal argument would not
131 necessarily directly affect men's ability to compete for resources in this way. Indeed,
132 if the possible effects of social dominance on dominance sensitivity observed in prior
133 work are simply a by-product of the correlation between physical and social
134 dominance in men, then the effect of losing versus winning imagined confrontations
135 may depend on the nature of the confrontation that was imagined (i.e., increased
136 sensitivity to dominance cues should occur when participants imagined physical
137 fights, but not when they imagined verbal arguments). If physical dominance and
138 social dominance both shape dominance sensitivity independently, however, then
139 the effect of losing versus winning imagined confrontations may be unaffected by the
140 nature of the confrontation that was imagined (physical fight versus verbal
141 argument).

142

143 In addition to investigating whether priming men with contest outcomes influences
144 their perceptions of the dominance of masculinized versus feminized versions of
145 men's faces, we also investigated whether a similar priming effect occurs for
146 judgments of masculinized versus feminized men's trustworthiness. We compared
147 the effects of priming on perceptions of facial dominance and trustworthiness in light
148 of recent research suggesting that these perceptions can be dissociated (Oosterhof
149 & Todorov 2008; see also Jones et al., 2011). For example, Oosterhof and Todorov
150 (2008) found that ratings of faces mapping onto perceptions of dominance and those
151 mapping more closely on to perceptions of trustworthiness were orthogonal, while
152 Jones et al. (2011) found that observing others' responses to aggressors influenced
153 dominance ratings of the aggressors, but not ratings of their trustworthiness. Thus, if
154 the effect of priming on men's perceptions of masculinized versus feminized faces is
155 primarily related to perceptions of dominance, we would expect priming to affect
156 dominance perceptions but would not necessarily expect it to affect perceptions of
157 men's trustworthiness.

158

159 **Methods**

160 **Experiment 1. Dominance perceptions**

161 ***Participants***

162 Seventy-three heterosexual men (mean age=23.7 years, SD=5.35 years) completed
163 the experiment online. Participants were recruited from links on social bookmarking
164 websites, such as stumbleupon. Previous research on perceptions of the dominance
165 of masculinized versus feminized faces has demonstrated that laboratory and online
166 studies produce equivalent results (e.g., Senior et al., 1999a, 1999b; Watkins et al.,
167 2010b). Responses from duplicate IP addresses were not recorded.

168

169 ***Stimuli***

170 Following previous studies of perceptions of the dominance of masculinized versus
171 feminized faces (e.g., Jones et al., 2010; Watkins et al., 2010a, 2010b), we used
172 prototype-based image transformations to objectively and systematically manipulate
173 sexually dimorphic aspects of 2D shape in digital face images. Following these
174 studies, 50% of the linear differences in 2D shape between symmetrized versions of
175 a male and a female prototype were added to or subtracted from digital face images
176 of 20 young White adult men (see Tiddeman et al., 2001 for technical details). The
177 resultant masculinized and feminized versions of the individual face images differ in
178 sexually dimorphic aspects of 2D shape, but are matched in other regards (e.g.,
179 identity, symmetry, skin color and texture, Rowland & Perrett, 1995). Examples of
180 masculinized and feminized face images are shown in Figure 1.

181

182 INSERT FIGURE 1 AROUND HERE

183

184 This process created 20 pairs of male face images in total, each pair consisting of a
185 masculinized and a feminized version of the same individual. Previous studies have
186 demonstrated that this method for manipulating masculinity of 2D face shape affects
187 perceptions of facial masculinity, dominance, and physical strength in the predicted
188 manner (e.g., DeBruine et al., 2006; Jones et al., 2010) and that masculinizing men's
189 faces using these methods increases perceptions of both physical and social
190 dominance (Watkins et al., 2010b).

191

192 ***Procedure***

193 The experiment consisted of two parts; an initial priming phase and, subsequently, a
194 dominance perception test.

195

196 In the initial priming phase of the experiment, each participant was randomly
197 allocated to one of four conditions: a condition where they were instructed to imagine
198 winning a physical fight, a condition where they were instructed to imagine losing a
199 physical fight, a condition where they were instructed to imagine winning a verbal
200 argument, or a condition where they were instructed to imagine losing a verbal
201 argument. Participants were given the following instructions: "Please take a moment
202 to imagine that you have just been involved in a verbal argument/physical fight with
203 someone of the same sex and age as you and that you won/lost the argument/fight.
204 Imagine how winning/losing the argument/fight made you feel and visualize yourself
205 winning/losing the argument/fight." Before moving on to the dominance test,
206 participants also rated how vividly they had imagined the confrontation on a 1 (not
207 very vivid) to 7 (very vivid) scale. Recent work on the effects of imagery on
208 perception has shown that participants can accurately rate the vividness of their
209 mental imagery (Pearson et al., 2011).

210

211 Immediately after the initial priming phase of the experiment, participants completed
212 the dominance perception test, which was identical to those used in several other
213 recent studies of men's sensitivity to dominance cues in other men (e.g., Watkins et
214 al., 2010a). In this test, participants were shown the 20 pairs of male faces, each pair
215 consisting of a masculinized and feminized version of the same individual, and were
216 instructed to indicate which face in each pair looked the more dominant. Participants
217 also indicated whether the more dominant face in each pair looked 'much more

218 dominant', 'more dominant', 'somewhat more dominant', or 'slightly more dominant'
219 than the other face in the pair. Trial order and the side of the screen on which any
220 given image was shown were fully randomized.

221

222 ***Initial processing of data***

223 Following prior research on systematic variation in dominance perception (Watkins et
224 al., 2010a), responses on the dominance perception test were coded using the
225 following scale:

226

227 0 to 3: feminized face rated 'much more dominant' (=0), 'more dominant' (=1)
228 'somewhat more dominant' (=2) or 'slightly more dominant' (=3) than masculinized
229 face.

230

231 4 to 7: masculinized face rated 'slightly more dominant' (=4), 'somewhat more
232 dominant' (=5), 'more dominant' (=6) or 'much more dominant' (=7) than feminized
233 face.

234

235 We then calculated each participant's average score on the dominance perception
236 test. Higher values indicate a stronger tendency to perceive masculine men as more
237 dominant than feminine men (i.e., greater sensitivity to dominance cues in men's
238 faces). Scores were normally distributed (Kolmogorov-Smirnov test: $Z=1.22$, $p=.10$).

239

240 ***Statistical analyses***

241 First, we used a one-sample t-test to compare men's scores on the dominance
242 perception test with what would be expected by chance alone (i.e. 3.5). We then

243 carried out an ANOVA with men's scores on the dominance perception test as the
244 dependent variable and *confrontation type* (physical fight, verbal argument) and
245 *confrontation outcome* (win, loss) as the between-subjects factors. Finally, we
246 conducted a second ANOVA, in which men's ratings of how vividly they had
247 imagined the confrontation was entered as the dependent variable.

248

249 **Experiment 2. Trustworthiness perceptions**

250 The procedure and stimuli in this experiment were identical to those used to
251 investigate the effects of priming on dominance perceptions, except that a different
252 group of 70 men took part in this experiment (mean age=22.16 years, SD=4.42
253 years) and they were asked to indicate which face in each pair looked more
254 trustworthy. To participate in the experiments, participants first had to register with
255 our website. This second experiment (trustworthiness) was not presented to those
256 individuals who had participated in the dominance experiment. As in the dominance
257 perceptions experiment, responses from duplicate IP addresses were not recorded.

258

259 Initial processing of data was identical to the dominance perception experiment,
260 except that high scores here indicate that masculinized faces were perceived as
261 more trustworthy. Scores were normally distributed (Kolmogorov-Smirnov test:
262 $Z=0.82$, $p=.55$). Statistical analyses were identical to those used to investigate the
263 effects of priming on dominance perceptions. We also carried out an additional
264 ANOVA (the combined analysis), in which we pooled the data from the dominance
265 and trustworthiness experiments and included *judgment type* (dominance,
266 trustworthiness) as an additional between-subjects factor.

267

268 **Results**

269 ***Experiment 1. Dominance perceptions***

270 Consistent with prior research (e.g., DeBruine et al., 2006; Jones et al., 2010; Perrett
271 et al., 1998), men generally perceived masculinized versions of men's faces to be
272 more dominant than feminized versions ($t(72) = 10.39$; $p < .001$; $M = 4.73$, $SEM = .12$,
273 $d = 1.22$). Additionally, the first ANOVA revealed a significant main effect of
274 *confrontation outcome* ($F(1,73) = 4.80$, $p = .032$, partial $\eta^2 = .065$), whereby men
275 allocated to the losing conditions perceived a larger difference in dominance
276 between the masculinized and feminized versions of men's faces ($M = 5.03$,
277 $SEM = 0.17$) than did men allocated to the winning conditions ($M = 4.51$, $SEM = 0.16$).
278 Neither the effect of *confrontation type* ($F(1,73) = 0.15$, $p = .70$, partial $\eta^2 = .002$), nor
279 the interaction between *confrontation type* and *confrontation outcome* ($F(1,73) = 0.78$,
280 $p = .38$, partial $\eta^2 = .011$), was significant. The second ANOVA revealed no significant
281 effects (all $F < 2.22$, all $p > .14$, partial $\eta^2 < .032$), indicating that the rated vividness of
282 the imagined confrontations was equivalent across scenarios and suggesting that
283 our findings for dominance sensitivity do not reflect differences in the perceived
284 vividness of the imagined scenarios among the experimental conditions.

285

286 ***Experiment 2: Trustworthiness perceptions***

287 Consistent with prior work (e.g., Perrett et al., 1998), men generally perceived
288 masculinized versions of men's faces to be *less* trustworthy than feminized versions
289 ($t(69) = -4.60$, $p < .001$, $M = 3.05$, $SEM = 0.10$, $d = 0.55$). The ANOVAs revealed no
290 significant effects for analyses of either trustworthiness perceptions (all $F < 0.85$, all
291 $p > .36$, all partial $\eta^2 < .014$) or how vividly participants reported having imagined the

292 confrontation during the priming phase of the experiment (all $F < 0.74$, all $p > .39$, all
293 partial $\eta^2 < .012$).

294

295 ***Combined analysis: Comparing the priming effects on perceptions of***
296 ***dominance and trustworthiness***

297 This final ANOVA revealed the predicted two-way interaction between *confrontation*
298 *outcome* and *judgment type* ($F(1,135) = 5.14$, $p = .025$, partial $\eta^2 = .037$), confirming
299 that priming had significantly different effects on perceptions of the dominance and
300 trustworthiness of masculine versus feminine men.

301

302 **Discussion**

303 Consistent with findings from many prior studies, masculine men were generally
304 perceived to be more dominant than feminine men. Additionally, and as we had
305 predicted, men who were randomly allocated to conditions where they imagined
306 losing a confrontation perceived a greater difference in the dominance of masculine
307 versus feminine men than did men who were randomly allocated to conditions where
308 they imagined winning a confrontation. This effect of priming on men's dominance
309 sensitivity suggests that men's perceptions of dominance cues in other men are
310 facultative, changing in response to their experiences of winning or losing recent
311 confrontations. These facultative responses are consistent with previous work
312 demonstrating that the outcomes of recent confrontations modulate competition-
313 related behaviors (e.g., escalation of aggressive conflict) in many non-human
314 species (reviewed in Hsu et al., 2006)

315

316 Importantly, the effect of imagining losing versus winning confrontations on men's
317 subsequent dominance sensitivity did not interact with the type of confrontation that
318 participants were instructed to imagine in the priming phase of the experiment (a
319 physical fight versus a verbal argument). That the effect of the *outcome* of the
320 confrontation was not qualified by the *type* of confrontation suggests that facultative
321 changes in men's sensitivity to dominance cues in potential rivals are shaped by
322 experiences of both physical and social confrontations. Less physically dominant
323 men and less socially dominant men may incur more substantial costs if they are
324 relatively insensitive to dominance cues in potential rivals because they are less
325 likely to be physically equipped to offset the costs of indiscriminate engagement in
326 conflict and their social status affords them little protection from more dominant
327 rivals, respectively (Watkins et al., 2010a, 2010b; Wrangham & Wilson, 2004).
328 Indeed, research on the reasons why young men join gangs suggests that they do
329 so, at least in part, because the improved status that comes with gang membership
330 also allows them to form alliances with individuals who can protect them from
331 physical violence (Decker & Curry, 2000). Thus, the facultative responses observed
332 in our dominance perception experiment may play a critical role in calibrating men's
333 dominance sensitivity, especially when in new environments or groups.

334

335 Error Management Theory (Haselton & Buss, 2000) proposes that, where errors of
336 one type are more costly than errors of another type, this can result in a tendency to
337 bias behavior towards errors of the less costly type. Our findings showing that
338 imagining losing confrontations increases dominance sensitivity, together with those
339 reporting negative correlations between measures of men's own dominance and
340 their dominance sensitivity (Watkins et al., 2010a, 2010b), present novel converging

341 evidence for this theory by demonstrating that dominance sensitivity is greatest
342 among men primed with scenarios in which they lost a confrontation (i.e., ‘cautious
343 losers’) and low-dominance men. Our findings also complement other recent work
344 demonstrating social transmission of dominance rank information among men
345 (Jones et al., 2011). While this prior work demonstrated that observing the outcomes
346 of confrontations between other men influenced how dominant the aggressors were
347 perceived to be (Jones et al., 2011), the current experiment’s findings suggest that
348 the outcomes of men’s own recent confrontations also influence their dominance
349 sensitivity. Collectively, these findings underline the critical role that recent
350 confrontations, both observed and experienced, play in shaping men’s dominance
351 perceptions. Indeed, that both the outcomes of men’s own confrontations (the
352 current study) and observing the outcomes of other men’s confrontations (Jones et
353 al., 2011) modulate perceptions of men’s dominance, but not trustworthiness,
354 highlights the sophisticated, relatively domain-specific processes through which
355 men’s experiences recalibrate competition-related perceptions and, potentially,
356 behaviors.

357

358 A caveat to our proposal that the outcome of physical confrontations recalibrates
359 men’s perceptions of their own physical dominance, while the outcome of verbal
360 arguments recalibrates men’s perceptions of their own social dominance, is that
361 winning or losing verbal arguments would not necessarily map onto common
362 definitions of social dominance, which normally contain direct references to
363 leadership and respect (Mueller & Mazur, 1996; see also, e.g., Puts et al., 2006 and
364 Watkins et al., 2010b). Consequently, participants may have interpreted the verbal
365 argument scenario as implicating some form of physical intimidation (i.e., one could

366 win a verbal argument by physically intimidating the other individuals). Additionally,
367 the null finding for the interaction between *confrontation type* and *confrontation*
368 *outcome* is subject to the perennial problem of how best to interpret null findings. For
369 these reasons, we suggest that the null finding for the interaction between
370 *confrontation type* and *confrontation outcome* should be interpreted with a degree of
371 caution. Nonetheless, our findings more clearly demonstrate an effect of
372 *confrontation outcome*, even if the extent to which this effect is specific to certain
373 types of confrontation remains unclear.

374

375 A further limitation is that participants were simply asked to judge men's dominance,
376 which was neither explained nor defined for them. On this point, we note that many
377 previous studies have reported extremely high inter-rater agreement for dominance
378 ratings of this type (e.g., Fink et al., 2007), suggesting that raters interpret such
379 instructions in a consistent manner. Moreover, we note here that previous studies
380 have reported that masculine characteristics have similar effects on men's
381 perceptions of other men's physical and social dominance (Puts et al., 2006; Watkins
382 et al., 2010b) and that individual differences in the extent to which men perceive
383 masculinized faces to be more physically and socially dominant than feminized
384 versions are positively correlated (Watkins et al., 2010b). These findings suggest
385 that contextual factors, such as recent confrontation outcomes, may well have similar
386 effects on men's perceptions of other men's physical and social dominance.

387 Nonetheless, we acknowledge that directly comparing the effects of confrontation
388 outcomes on perceptions of men's physical and social dominance may well be an
389 interesting topic for future research.

390

391 In summary, we used a priming paradigm to demonstrate that men who imagined
392 losing either a physical confrontation or a verbal argument were subsequently more
393 sensitive to facial cues of men's dominance than were men who imagined winning a
394 confrontation or argument. Calibrating dominance sensitivity in this way (i.e., in light
395 of the outcomes of recent confrontations) could be important for minimizing the
396 potential costs of within-sex competition, particularly in new environments or when
397 interacting with unfamiliar individuals. While other recent priming studies have
398 revealed facultative preferences for facial characteristics in potential mates (e.g.,
399 Little et al., 2011), here we show that priming paradigms can also be used to
400 demonstrate facultative perceptions of the dominance of same-sex rivals that
401 complement facultative competition-related responses that have been observed in
402 other species (Hsu et al., 2006).

403

404

405 **References**

- 406 Bergeron, P., Grignolio, S., Apollonio, M., Shipley, B. & Festa-Bianchet, M. (2010).
407 Secondary sexual characters signal fighting ability and determine social rank
408 in Alpine ibex (*Capra ibex*). *Behavioral Ecology and Sociobiology*, 64, 1299-
409 1307.
- 410 Boothroyd, L. G., Jones, B. C., Burt, D. M., Perrett, D. I.. (2007). Partner
411 characteristics associated with masculinity, health and maturity in male faces.
412 *Personality and Individual Differences*, 43, 1161–1173.
- 413 Carre, J.M., McCormick, C.M. & Mondloch, C.J. (2009). Facial structure is a reliable
414 cue of aggressive behaviour. *Psychological Science*, 20, 1194–1198.
- 415 Chen, S., Shechter, D. & Chaiken, S. (1996). Getting at the truth or getting along:
416 Accuracy- versus impression-motivated heuristic and systematic processing.
417 *Journal of Personality and Social Psychology*, 71, 262-275.
- 418 Decker, S. H. & Curry, G. D. (2000). Addressing key features of gang membership
419 measuring the involvement of young members. *Journal of Criminal Justice*,
420 28, 473-482.
- 421 DeBruine, L.M., Jones, B.C., Little, A.C., Boothroyd, L.G., Perrett, D.I., Penton-Voak,
422 I.S., Cooper, P.A., Penke, L., Feinberg, D.R. & Tiddeman, B.P. (2006).
423 Correlated preferences for facial masculinity and ideal or actual partner's
424 masculinity. *Proceedings of the Royal Society of London B*, 273, 1355-1360.
- 425 Emlen, D. J. (2008). The evolution of animal weapons. *Annual Review of Ecology,*
426 *Evolution, and Systematics*, 39, 387-413.
- 427 Fink, B., Neave, N. & Seydel, H. (2007). Male facial appearance signals physical
428 strength to women. *American Journal of Human Biology*, 19, 82-87.

- 429 Gangestad, S. W., Merriman, L. A. & Thompson, M. E. (2010). Men's oxidative
430 stress, fluctuating asymmetry and physical attractiveness. *Animal Behaviour*,
431 80, 1005-1013.
- 432 Goldberg, L.R. (1999). A broad-bandwidth, public domain, personality inventory
433 measuring the lower-level facets of several five-factor models. In I. Mervielde,
434 I. Deary, F. De Fruyt & F. Ostendorf (Eds.), *Personality Psychology in Europe*,
435 7, (pp. 7-28). Tilburg: Tilburg University Press.
- 436 Haselton M. G. & Buss, D. M. (2000). Error management theory: A new perspective
437 on biases in cross-sex mind reading. *Journal of Personality and Social*
438 *Psychology*, 78, 81-91.
- 439 Hsu, Y. & Wolf, L. L. (2001). The winner and loser effect: What fighting behaviours
440 are influenced? *Animal Behaviour*, 61, 777-786.
- 441 Hsu, Y., Earley, R. L. & Wolf, L. L. (2006). Modulation of aggressive behaviour by
442 fighting experience: Mechanisms and contest outcomes. *Biological Reviews*,
443 81, 33-74.
- 444 Jones, B. C., DeBruine, L. M., Little, A. C., Watkins, C. D. & Feinberg, D. R. (2011).
445 'Eavesdropping' and perceived male dominance rank in humans. *Animal*
446 *Behaviour*, 81, 1203-1208.
- 447 Jones, B.C., DeBruine, L.M., Main, J.C., Little, A.C., Welling, L.L.M., Feinberg, D.R.
448 & B.P. Tiddeman (2010). Facial cues of dominance modulate the short-term
449 gaze-cuing effect in human observers. *Proceedings of the Royal Society of*
450 *London B*, 277, 617-624.
- 451 Keating, C. F., & Bai, D. L. (1986). Children's attributions of social dominance from
452 facial cues. *Child Development*, 57, 1269-1276.

- 453 Keating, C. F., Mazur, A. & Segall, M. H. (1981). A cross-cultural exploration of
454 physiognomic traits of dominance and happiness. *Ethology and Sociobiology*,
455 2, 41-48.
- 456 Little, A. C., DeBruine, L. M. & Jones, B. C. (2011). Exposure to visual cues of
457 pathogen contagion changes preferences for masculinity and symmetry in
458 opposite-sex faces. *Proceedings of the Royal Society of London B*, 278,
459 2032-2039.
- 460 Little, A. C., Cohen, D. L., Jones, B. C. & Belsky, J. (2007). Human preferences for
461 facial masculinity change with relationship type and environmental harshness.
462 *Behavioral Ecology and Sociobiology*, 61, 967–973.
- 463 Malo, A. F., Roldan, E. R. S., Garde, J. J., Soler, A. J., Vicente, J., Gortazar, C. &
464 Gomendio, M. (2009). What does testosterone do for red deer males?
465 *Proceedings of the Royal Society of London B*, 276, 971-980.
- 466 Maner, J. K., Miller, S. L., Rouby, D. A., & Gailliot, M. T. (2009). Intrasexual
467 vigilance: The implicit cognition of romantic rivalry. *Journal of Personality and*
468 *Social Psychology*, 97, 74-87.
- 469 Marty, J. S., Higham, J. P., Gadsby, E. L. & Ross, C. (2009). Dominance, coloration,
470 and social and sexual behavior in male Drills *Mandrillus leucophaeus*.
471 *International Journal of Primatology*, 30, 807-823.
- 472 Mehta, P. H. & Josephs, R. A. (2006). Testosterone change after losing predicts the
473 decision to compete again. *Hormones and Behavior*, 50, 684-692.
- 474 Mueller, U. & Mazur, A. (1996). Facial dominance in Homo sapiens as honest
475 signaling of male quality. *Behavioral Ecology*, 8, 569-579.
- 476 Oosterhof, N. N. & Todorov, A. (2008). The functional basis of face evaluation.
477 *Proceedings of the National Academy of Sciences*, 105, 11087-11092.

- 478 Pearson, J., Rademaker, R. & Tong, F. (2011). Evaluating the mind's eye: The
479 metacognition of visual imagery. *Psychological Science*, in press.
- 480 Pelletier, F. & Festa-Bianchet, M. (2006). Sexual selection and social rank in bighorn
481 rams. *Animal Behaviour*, *71*, 649-655.
- 482 Perrett, D.I., Lee, K.J., Penton-Voak, I.S., Rowland, D.R., Yoshikawa, S., Burt, D.M.,
483 Henzi, S.P., Castles, D.I. & Akamatsu, S. (1998). Effects of sexual
484 dimorphism on facial attractiveness. *Nature*, *394*, 884-887.
- 485 Preston, B. T., Stevenson, I. R., Pemberton, J. M., Coltman, D. W. & Wilson, K.
486 (2003). Overt and covert competition in a promiscuous mammal: the
487 importance of weaponry and testes size to male reproductive success.
488 *Proceedings of the Royal Society of London B*, *270*, 633-640.
- 489 Puts, D.A. (2010). Beauty and the beast: Mechanisms of sexual selection in humans.
490 *Evolution and Human Behavior*, *31*, 157-175.
- 491 Puts, D.A., Gaulin, S.J.C. & Verdolini, K. (2006). Dominance and the evolution of
492 sexual dimorphism in human voice pitch. *Evolution and Human Behavior*, *27*,
493 283-296.
- 494 Rowland, D.A. & Perrett, D.I. (1995). Manipulating facial appearance through shape
495 and colour. *IEEE Computer Graphics and Applications*, *15*, 70-76.
- 496 Santos, E. S. A., Scheck, D. & Nakagawa, S. (2011). Dominance and plumage traits:
497 meta-analysis and metaregression analysis. *Animal Behaviour*, *82*, 3-19.
- 498 Sell, A., Cosmides, L., Tooby, J., Sznycer, D., von Rueden, C. & Gurven, M. (2009).
499 Human adaptations for the visual assessment of strength and fighting ability
500 from the body and face. *Proceedings of the Royal Society of London B*, *276*,
501 575-584.

- 502 Senior, C., Barnes, J., Jenkins, R., Landau, S., Philips, M. L., & David, A. S. (1999a).
503 Attribution of social dominance and maleness to schematic faces. *Social*
504 *Behavior and Personality*, 27, 331–338.
- 505 Senior, C., Philips, M. L., Barnes, J., & David, A. S. (1999b). An investigation into the
506 perception of dominance from schematic faces: A study using the World-Wide
507 Web. *Behavior Research Methods, Instruments and Computers*, 31, 341–346.
- 508 Thomsen, L., Frankenhuys, W. E., Ingold-Smith, M. & Carey, S. (2011). Big and
509 mighty: Preverbal infants mentally represent social dominance. *Science*, 331,
510 477-480.
- 511 Utz, S., Ouwerkerk, J. P. & Van Lange, P. A. M. (2004). What is smart in a social
512 dilemma? Differential effects of priming competence on cooperation.
513 *European Journal of Social Psychology*, 34, 317-332.
- 514 Watkins, C.D., Fraccaro, P., Smith, F.G., Vukovic, J., Feinberg, D.R., DeBruine, L.M.
515 & Jones, B.C. (2010a). Taller men are less sensitive to cues of dominance in
516 other men. *Behavioral Ecology*, 21, 943-947.
- 517 Watkins, C.D., Jones, B.C. & DeBruine, L.M. (2010b). Individual differences in
518 dominance perception: Dominant men are less sensitive to facial cues of male
519 dominance. *Personality and Individual Differences*, 49, 967-971.
- 520 Wilson, M. L., Hauser, M. D. & Wrangham, R. W. (2001). Does participation in
521 intergroup conflict depend on numerical assessment, range location, or rank
522 for wild chimpanzees? *Animal Behaviour*, 61, 1203-1216.
- 523 Wolff, S.E. & Puts, D.A. (2010). Vocal masculinity is a robust dominance signal in
524 men. *Behavioral Ecology and Sociobiology*, 64, 1673-1683.

525 Wrangham, R.W. & Wilson, M.L. (2004). Collective violence: Comparisons between
526 youths and Chimpanzees. *Annals of the New York Academy of Sciences*,
527 1036, 233-256.

528

529 **Figure Captions**

530 **Figure 1.** Examples of masculinized (left) and feminized (right) versions of male
531 faces used in Experiment 1 and Experiment 2.

532