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1 Jealousy as a Function of Rival Characteristics: Two large replication studies and
2 meta-analyses support gender differences in reactions to rival attractiveness but not
3 dominance.

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Abstract

13

14 Jealousy is a key emotion studied in the context of romantic relationships. One seminal
15 study (Dijkstra, P., & Buunk, B. (1998). Jealousy as a function of rival characteristics: An
16 evolutionary perspective. *Personality and Social Psychology Bulletin*, 24(11), 1158–1166.
17 <https://doi.org/10.1177/01461672982411003>) investigated the interactions between a
18 participant's gender, and their reactions to the attractiveness or dominance of a romantic
19 rival. In a vignette-based study, they found that women's jealousy was more responsive than
20 men's to a rival's attractiveness, whereas in contrast, the rival's dominance evoked more
21 jealousy from men than from women. Here, we attempt to replicate these interactions in two
22 samples (N=339 and N=456), and present subsequent meta-analyses (combined Ns= 5,899
23 & 4,038, respectively). These meta-analyses showed a small, significant effect of gender on
24 jealousy provoked by rival attractiveness, but no such response to rival dominance. We
25 discuss the potential reasons for these findings, and future directions for research on jealousy
26 and rival characteristics.

27 *Keywords:* Jealousy; Rival characteristics; Replication; Evolutionary Psychology; Sex
28 Differences

29 Word count: 9822 (main text, incl. references)

30 Jealousy as a Function of Rival Characteristics: Two large replication studies and
31 meta-analyses support gender differences in reactions to rival attractiveness but not
32 dominance.

33 The differences between men and women in the nature of their romantic jealousy have
34 been studied in dozens of empirical research papers (reviews and meta-analyses in Buss,
35 2018; Carpenter, 2012; Edlund & Sagarin, 2017; Harris, 2003; Sagarin et al., 2012), and
36 presented as a test case of predictions derived from evolutionary psychology (e.g., Sesardic,
37 2003). Men (but not women) can be at risk of raising a child that they mistakenly believe to
38 be a genetic relative as a consequence of their partner's sexual infidelity. This is not a risk
39 that women face, but in contrast, a woman's reproductive success depends in part upon the
40 resources brought by her partner, something that could be threatened by her partner falling
41 in love with someone else (emotional infidelity), and channeling resources away. Given these
42 differences in the threats faced by men and women, researchers have predicted and
43 frequently found differences in how much men's and women's jealousy is provoked by sexual
44 or emotional infidelity. In a typical research design, where people are asked to decide
45 whether they would be more distressed by sexual or emotional infidelity, men tend towards
46 the former more than women do, whereas the opposite pattern is true of women.

47 This research programme is not without controversy (Buss, 2018; Carpenter, 2012;
48 Edlund & Sagarin, 2017; Harris, 2003; Sagarin et al., 2012). Some researchers perceive that
49 sex differences in jealousy exist because natural selection has acted directly and
50 independently on men's and women's psychology to instill their specific natures, deriving
51 from the differences in costs to men and women of a partner's sexual or emotional infidelity
52 (e.g., Buss, 2000). Others question the extent to which we need posit that differences
53 between men and women have been so canalised by processes of natural selection. Harris's
54 (2003) socio-cognitive theory of jealousy does not throw aside the role of natural selection,
55 but instead considers evolution to have shaped a cognition that can respond more flexibly to

56 the environment. Under that formulation, jealousy might be provoked to the extent that
57 people perceive that a rival challenges them in relation to their representations of themselves,
58 or threatens the rewards that they currently gain from a relationship. Alternatively again,
59 other researchers have focussed their attention on the biosocial constructions of differences
60 between men and women in their behaviour (Wood & Eagly, 2012).

61 Researchers who prefer more socially-constructed explanations of gender differences in
62 behaviour have considered null findings or heterogeneity in findings of male / female
63 differences in jealousy to be supportive of their theories, because they point out that the
64 contingencies of social and cultural exposure will lead to variability across samples in terms
65 of the differences between men and women. This position has fuelled ongoing debate over
66 whether the noted differences in jealousy between men and women are only apparent in some
67 research designs (see Carpenter, 2012; Edlund & Sagarin, 2017; Harris, 2003; Sagarin et al.,
68 2012). Irrespective, there is greater consensus across the different camps that the
69 documented gender differences in jealousy exist most clearly in people to the extent that
70 they are young, or heterosexual, or students, or American (Carpenter, 2012; Harris, 2003;
71 Sagarin et al., 2012).

72 **A Replication of Dijkstra and Buunk (1998)**

73 Despite the raft of controversies, evolutionary thinking on jealousy has also been used
74 to predict how men and women differ in terms of which traits of a potential rival should
75 most provoke their jealousy, as in a seminal study by Dijkstra and Buunk (1998). Dijkstra
76 and Buunk (1998) focussed on differences between men and women in their reactions to the
77 dominance and attractiveness of a potential rival. A man's dominance might testify to his
78 ability to provide resources (e.g., Buss, 1994), whereas a woman's physical attractiveness
79 might provide cues to her fertility, age, and physical condition (e.g., Symons, 1979). As such,
80 these characteristics are associated with high-quality partners, and desired differentially in

81 men and women the world over (see Buss, 1989). Dijkstra and Buunk presented participants
82 with vignettes that described imaginary interactions between a man and a woman, one of
83 whom was the participant's partner, and the other of whom was a rival. The authors
84 hypothesised that women would be particularly jealous of female rivals who were attractive
85 rather than unattractive, while dominance should not be of great importance. In contrast,
86 men would be particularly jealous when the male rival was high rather than low in
87 dominance, and attractiveness of the rival would matter less.

88 Dijkstra and Buunk (1998) conducted a three-way ANOVA and found a significant
89 Gender*Attractiveness*Dominance interaction with a sample of 152 students. Yet the key
90 evidence presented by Dijkstra and Buunk were two further significant interaction tests in
91 ANOVA (Gender*Attractiveness, Gender*Dominance). Participant gender interacted with
92 the attractiveness of the rival, leading women to respond with more jealousy to an attractive
93 rival, as opposed to an unattractive one, compared to men (interaction: $\eta_p^2 = .033$, based on
94 our own calculations). In contrast, the dominance of the rival affected men to a greater
95 degree than it did women (interaction: $\eta_p^2 = .026$, based on our own calculations). While the
96 effects were statistically significant, their size was relatively small (Cohen, 1969).

97 Subsequent to Dijkstra and Buunk (1998), there has been a suite of papers examining
98 rival characteristics and their effects on jealousy [e.g., Buunk and Dijkstra (2001); Dijkstra
99 and Buunk (2002); O'Connor and Feinberg (2012); Lei, Wang, Han, DeBruine, and Jones
100 (2019); Zurriaga, González-Navarro, Buunk, and Dijkstra (2018); see Discussion for details].
101 Beyond inspiring much other research, the study by Dijkstra and Buunk (1998) is also cited
102 in handbooks on close relationships, evolutionary psychology, and social psychology (e.g.,
103 Brehm, 2002; Hendrick & Hendrick, 2000; Neuberg, Kenrick, & Schaller, 2010; Schmitt,
104 2005). Thus, it is important to re-examine this seminal study and conduct a close replication.
105 The necessity of revisiting earlier findings is further underlined by the current replication
106 crisis in psychology, generating momentum to reappraise earlier work (Open Science

107 Collaboration, 2015). Independent replication is the cornerstone for psychological science
108 (e.g., Zwaan, Etz, Lucas, & Donnellan, 2018).

109 We evaluate the same two key hypotheses as Dijkstra and Buunk (1998). We predict a
110 two-way interaction between gender and attractiveness, with women surpassing men in terms
111 of how much their jealousy is provoked by the attractiveness of the rival. We also predict a
112 two-way interaction between gender and dominance of the rival, with men's jealousy being
113 more reactive than women's to the rival's dominance.

114 **Study 1.**

115 **Methods**

116 **Participants**

117 The sample size was determined by the time frame allocated to two Bachelor students
118 who completed data collection. The target sample size was 2.5 times the sample original
119 study ($152 \times 2.5 = N$ of 380), as recommended by Simonsohn (2015), of which we fell slightly
120 short. Our target population was unmarried, young adults, who had at least experienced one
121 romantic relationship (including ongoing relationships). Some participants completed the
122 study online ($N = 271$), while others were approached on a campus of a large UK University
123 ($N = 98$) and completed the study on a tablet or their own device. The restriction of being
124 unmarried was added as married individuals might respond differently to questions about
125 jealousy (White, 1981). Given that there were no statistically significant interactions
126 between the study site (online vs campus) and the manipulation (Attractiveness/Dominance)
127 on jealousy, we merged the samples ($N = 369$). While Dijkstra and Buunk (1998) did not
128 specify whether they applied this criterion, we limited the sample to self-identified
129 heterosexual participants ($N = 339$; 225 women). The majority were current students (55%)

130 and in a relationship (66%). The mean age was 22.48 years ($SD = 3.75$ years, range = 18 -
131 57 years); the age of the participants recruited by Dijkstra and Buunk (1998) is not reported,
132 but they are described as undergraduates.

133 **Materials**

134 We attempted to follow the materials by Dijkstra and Buunk (1998), the original study,
135 as closely as possible. The materials that we used are available on the Open Science
136 Framework (https://osf.io/zytdx/?view_only=e48db3ddebde41528741d04e814f44ff).

137 **Vignettes.** Our vignettes presented the same scenario as Dijkstra and Buunk (1998).
138 Participants read: “*You are at a party with your girlfriend [boyfriend], and you are talking*
139 *with some of your friends. You notice your girlfriend [boyfriend] across the room talking to a*
140 *man [woman] you do not know. You can see from his [her] face that he [she] is very*
141 *interested in your girlfriend [boyfriend]. He [She] is listening closely to what she [he] is*
142 *saying, and you notice that he [she] casually touches her [his] hand. You notice that he [she]*
143 *is flirting with her [him]. After a minute, your girlfriend [boyfriend] also begins to act*
144 *flirtatiously. You can tell from the way she [he] is looking at him [her] that she [he] likes him*
145 *[her] a great deal. They are completely absorbed in each other.”*

146 **Dominance manipulation.** Dijkstra and Buunk (1998) manipulated dominance
147 perception via a vignette written to capture high and low dominance items of the Dominance
148 subscale of a personality questionnaire (NPV, Luteijn, Starren, & Dijk, 1985). We replicated
149 the text, but altered the Dutch forenames and the university name. The high-dominance
150 description read as follows: “*You find out that your girlfriend is flirting with Jonathan, the*
151 *man in this photo. Jonathan is a student at [Name of University where study was conducted]*
152 *and is about the same age as you. Jonathan is also a teaching assistant and teaches courses*
153 *to undergraduates. He is also president of a [Name of University where study was conducted]*

154 *activities club that numbers about 600 members. Jonathan knows what he wants and is a*
 155 *good judge of character. Jonathan also often takes the initiative to do something new, and he*
 156 *has a lot of influence on other people. At parties, he always livens things up.” The*
 157 *low-dominance version read as follows: “You find out that your girlfriend is flirting with*
 158 *Jonathan, the man in the photo. Jonathan is a student at [Name of University where study*
 159 *was conducted] and is about the same age as you. Jonathan attends classes regularly and is*
 160 *one of the 600 members of an activities club at [Name of University where study was*
 161 *conducted]. Jonathan does not always know what he wants, and he often fails to understand*
 162 *what is going on in other people’s minds. Jonathan often waits for others to take the*
 163 *initiative and is rather compliant. At parties, he usually stays in the background.”*

164 For (heterosexual) women the name and gender of the rival were altered (“*Olivia*”
 165 rather than “*Jonathan*”).

166 **Attractiveness manipulation via photographs.** We contacted Pieterel
 167 Dijkstra for access to the original photographs but these were unavailable given the time lag
 168 since the original study; the requirement for new photographs allowed us to select stimuli
 169 that exhibited contemporary hairstyles and image quality, and so we drew our stimuli from a
 170 database of standardised photographs (DeBruine & Jones, 2017) that had been pre-rated for
 171 attractiveness on a 7-point scale, from 1= not at all, to 7 = very attractive, as in Dijkstra
 172 and Buunk (1998)’s original study. We matched the attractiveness levels of the stimuli as
 173 closely as possible to the original study (attractive female $M = 4.2$, “009_08.jpeg”, original
 174 study $M = 4.05$; unattractive female $M = 1.6$, “038_08.jpg”, original study $M = 1.05$;
 175 attractive male $M = 4.4$, “036_08.jpeg”, original study $M = 4.43$; unattractive male $M =$
 176 1.5 , “005_08.jpg”, original study $M = 1.05$). All individuals were smiling in their picture
 177 and the stimuli were 350 x 350 pixels (72dpi).

178 **Ratings of jealousy and other feelings.** After reading the vignette, participants
 179 used a 5-point scale (1 = not at all to 5 = very) to rate the extent to which the vignettes

180 would lead them to feel: jealous, distrustful, suspicious, worried, betrayed, hurt,
181 anxious, threatened, sad, and upset. Following Dijkstra and Buunk (1998), we focus on the
182 jealousy item.

183 **Manipulation check.** Participants completed a manipulation check on the
184 attractiveness of the rival in the vignette by answering the questions: “How attractive do
185 you think the person in the photo is?” and “How attractive do you believe this person is, in
186 comparison to yourself?” on a 7-point scale (1 = very attractive, 7 = not very attractive and
187 1 = far more attractive, 7 = far less attractive, respectively). To check the participants’
188 ratings of the rival’s dominance, participants were then asked to rate the rival on a 5-point
189 scale to indicate how typical (1 = not at all typical, 5 = very typical) the following six
190 characteristics were of the rival: assertive, self-confident, influential, good judge of character,
191 extraverted, and socially competent.

192 **Mate value.** As in Dijkstra and Buunk (1998), we included six items on
193 self-perceived mate value (e.g. “I can have as many sexual partners as I choose”) from
194 Landolt, Lalumière, and Quinsey (1995). These formed a coherent scale (Cronbach’s α : .88
195 [95%CI: .85 to .90]). Dijkstra and Buunk (1998) found that men and women differed in mate
196 value, with women reporting greater mate value. Thus, they included this measure as a
197 covariate in all their ANOVAs. It is unclear whether mate value is truly an extraneous
198 variable, and so it is debatable whether it is necessary to account for it in the proposed
199 ANOVAs (e.g., Jamieson, 2004; Schneider, Avivi-Reich, & Mozuraitis, 2015). In the Results
200 section, we further discuss this issue.

201 **Inclusion of Others in Self Scale (IoS).** Participants also completed the
202 Inclusion of Others in Self Scale (IoS, Aron, Aron, & Smollan, 1992) in order to measure how
203 close they believed themselves and their partner to be. They were asked to choose a response
204 from 7 Venn diagrams of overlap between themselves and their partner or previous partner
205 based on how interdependent or independent they believed they were. This measure was not

206 part of Dijkstra and Buunk (1998)'s paper, but was included for exploratory analysis for the
207 Bachelor thesis projects which made use of our data; this variable is not analyzed here. This
208 measure was completed after all the relevant measures for the replication study and therefore
209 could not influence any outcomes of what we present below.

210 **Procedure**

211 The study and its protocol were approved by the University's Ethics Committee.
212 Participants were recruited via social media adverts, or by direct approach by two
213 undergraduates (one man, one woman) with a tablet on a university campus of a large UK
214 university. Participants read an information sheet and then provided informed consent. Prior
215 to reading a scenario, participants answered some questions on sociodemographics, their
216 sexuality, and relationship status. Participants were then presented with a vignette which
217 described their current partner (whether real or imagined) flirting with a member of the
218 opposite sex. After reading this scenario, the participants were then randomly shown either
219 the high- or low-dominance descriptor, accompanied by either the attractive or unattractive
220 photograph (see above). Next, participants completed their ratings of jealousy and other
221 feelings, then the manipulation check questions, then the mate value questionnaire, then the
222 Inclusion of Others in Self scale (see above). Participants were then thanked and debriefed.

223 **Data analysis**

224 All analyses were conducted in R 3.6.1 (R Development Core Team, 2008). The
225 analyses were preregistered following Brandt et al. (2014)'s replication recipe on the Open
226 Science Framework. The data, code, and analysis document are all available from the [Open](#)
227 [Science Framework](#).

Results

228

229 Manipulation checks

230 **Attractiveness.** We replicated Dijkstra and Buunk (1998)'s findings that, amongst
231 the male raters, an ANOVA that examined the impact of the two types of photographs (high
232 vs low rival attractiveness) and two types of vignettes (high vs low rival dominance) on
233 perceived rival attractiveness ("How attractive do you think the person in the photo is?"),
234 provided evidence only for a significant main effect of attractiveness, $F(1, 110) = 257.70$, $p <$
235 $.0001$, $\eta_g^2 = .70$. Men rated the attractive rival as more attractive ($M = 3.04$, $SD = 1.28$,
236 original study: $M = 2.59$) than the unattractive rival ($M = 6.24$, $SD = .78$, original study:
237 $M = 4.92$). The same ANOVA, but switching the dependent variable to "How attractive do
238 you believe this person is, in comparison to yourself?", again revealed a significant main
239 effect of attractiveness, $F(1, 110) = 38.91$, $p < .0001$, $\eta_g^2 = .26$. Men gave higher ratings to
240 the attractive ($M = 3.86$, $SD = 1.48$, original study: $M = 2.82$) than the unattractive rival
241 ($M = 5.66$, $SD = 1.64$, original $M = 5.61$).

242 The manipulation checks similarly supported a successful manipulation of rival
243 physical attractiveness amongst female participants. In the corresponding 2 x 2 ANOVAs
244 there was only a significant main effect of rival attractiveness, $F(1, 221) = 259.54$, $p < .0001$,
245 $\eta_g^2 = .54$ on ratings of attractiveness, and $F(1, 221) = 91.10$, $p < .0001$, $\eta_g^2 = .29$ on ratings
246 of attractiveness compared to the self. Women rated the attractive rival as more attractive
247 ($M = 2.80$, $SD = 1.65$, original $M = 2.40$) than the unattractive rival ($M = 5.41$, $SD = 1.27$,
248 original $M = 5.09$). Women's ratings of rival attractiveness compared to themselves also
249 were higher in relation to the attractive rival ($M = 3.41$, $SD = 1.65$, original $M = 2.81$) than
250 to the unattractive rival ($M = 5.36$, $SD = 1.34$, original $M = 5.61$).

251 **Dominance.** Following Dijkstra and Buunk (1998), we conducted a 2 (high vs low
252 rival dominance) x 2 (high vs low rival attractiveness) MANOVA on the 6 dominance traits.

253 In line with the original study, participants who read the high-dominance version of the
254 vignettes gave higher ratings to all six of the dominance traits (male participants: Pillai's
255 Trace= .51, $F(6,105) = 17.70$, $p < .0001$; female participants: Pillai's Trace= .24, $F(6,213)$
256 = 11.06, $p < .0001$). All of the F -tests showed a statistically significant effect for dominance
257 of the rival for each of the 6 traits (male participants: all F 's (1,110) > 55 , all p 's $< .0001$;
258 female participants: all F 's (1,218) > 22 , all p 's $< .0001$). We did not find a statistically
259 significant ($p < .05$) main effect of attractiveness on dominance ratings in men, Pillai's
260 Trace= .09, $F(6,105) = 1.64$, $p = .145$ (compare Dijkstra and Buunk 1998's report of $p = .05$).
261 For women, we did find a statistically significant main effect of attractiveness on dominance
262 ratings, in line with Dijkstra and Buunk (1998), Pillai's Trace= .16, $F = 6.68$, $p < .0001$. The
263 F -tests showed a statistically significant effect for attractiveness of the rival on assertiveness,
264 self-confidence, extroversion, influence and social competence (all F 's (1,218) > 5 , $p <$
265 $.05$). The only exception was the trait of being a good judge of character, $F(1,218) = 3.70$, p
266 = .055. These results are largely similar to Dijkstra and Buunk (1998) who reported
267 statistically significant effects for all traits apart from social competence and being a good
268 judge of character.

269 In conclusion, our manipulations were successful and elicited largely similar effects as
270 Dijkstra and Buunk (1998). As discussed by Dijkstra and Buunk (1998), one cannot expect
271 a complete experimental disentanglement between the dominance and attractiveness
272 manipulations, as for example a manipulation of attractiveness is predicted to also affect
273 perceptions of overall character (Feingold, 1992).

274 **Mate value**

275 Dijkstra and Buunk (1998) added self-perceived mate value as a covariate in all of their
276 ANOVAs. In our study, men's self-perceived mate value ($M = 24.53$, $SD = 7.06$) did not
277 differ significantly from women's ($M = 25.85$, $SD = 6.98$; $t(225.24) = 1.64$, $p = .102$). We

278 therefore do not include mate value as a covariate in the analyses presented below, although
279 the results are qualitatively similar with the inclusion of the covariate (see analysis document
280 on the Open Science Framework:

281 https://osf.io/zytdx/?view_only=e48db3ddebde41528741d04e814f44ff).

282 **Hypothesis tests.**

283 **2 (rival physical attractiveness) x 2 (rival dominance) x 2 (gender)**

284 **ANOVA: effects on jealousy ratings.** Figure 1 presents the histograms by condition
285 for men and women.

286 **Please insert Figure 1 here.**

287 Unlike Dijkstra and Buunk (1998), the proposed 2 x 2 x 2 interaction (gender *
288 attractiveness * dominance) on ratings of jealousy was not statistically significant ($F(1, 331)$
289 $= 0.04$, $p = .849$, $\eta_g^2 < .01$). Yet, there was evidence for the hypothesized
290 Gender*Attractiveness interaction effect, $F(1, 331) = 6.55$, $p = .011$, $\eta_g^2 = .02$. For women,
291 an attractive rival, as opposed to an unattractive rival, elicited jealousy to a greater degree
292 than it did for men. There was no support for a Gender*Dominance interaction on jealousy,
293 $F(1, 331) = 1.44$, $p = .231$, $\eta_g^2 < .01$. No other effects were statistically significant, including
294 the main effect of dominance of the rival ($F(1, 331) = 3.17$, $p = .076$, $\eta_g^2 < .01$).

295 **Please insert Figures 2-3 here.**

296 **Analyses of jealousy by gender.** Figures 2 and 3 show the effects of gender on
297 ratings of jealousy, in comparison to the findings reported by Dijkstra and Buunk (1998).
298 For men, a 2 (rival attractiveness) x 2 (rival dominance) ANOVA showed that men were
299 significantly more jealous of attractive than unattractive rivals ($F(1, 110) = 4.73$, $p = .032$,
300 $\eta_g^2 = .04$), and of high-dominance than low-dominance rivals ($F(1, 110) = 5.45$, $p = .021$, η_g^2

301 = .05). Unlike Dijkstra and Buunk (1998), there was no suggestion of an interaction effect
302 ($F(1, 110) = 0.75, p = .389, \eta_g^2 < .01$). For women, a 2 (rival attractiveness) x 2 (rival
303 dominance) ANOVA found only evidence for a main effect of attractiveness ($F(1, 221) =$
304 $54.43, p < .001, \eta_g^2 = .20$). There was neither evidence for a significant effect of dominance of
305 the rival, nor for the interaction effect between attractiveness and dominance; $F(1, 221) =$
306 $1.34, p = .247, \eta_g^2 < .01$ and $F(1, 221) = 0.75, p = .389, \eta_g^2 < .01$, respectively.

307

Discussion

308 The study that we attempted to replicate by Dijkstra and Buunk (1998) found that, in
309 an imagined scenario when a participant watches their partner interact with a potential rival,
310 women's jealousy was provoked by the attractiveness of the female rival, whereas men's
311 jealousy was contingent upon the perceived dominance of the male rival. Specifically, the
312 original paper found a significant three-way interaction between participant gender, and the
313 attractiveness and dominance of the rival; this was not something that we were able to
314 replicate. The original paper also presented significant two-way interactions between
315 participant gender and attractiveness, and between participant gender and dominance. We
316 replicated the first but not the second of these two-way interactions: in our study, women's
317 jealousy was significantly more affected than men's by the attractiveness of the rival. In
318 analyses of men and women separately, we found that rival attractiveness but not rival
319 dominance affected women's jealousy ratings, whereas attractive or dominant rivals each
320 increased men's ratings of jealousy.

321 Sagarin et al. (2012) explain in detail why an interaction, and not main effects, is the
322 only test of a hypothesis around evolved sex differences (see also Buller, 2005 on the
323 importance of selecting the correct contrasts in investigating male/female differences in
324 jealousy). It is true that the men in our study were more jealous of dominant than
325 non-dominant men, but they were also more jealous of attractive than unattractive men. All

326 that tells us is that men are alert to socially desirable traits. The prediction of Dijkstra and
327 Buunk, in contrast, states specifically that men, compared to women, should be more upset
328 by dominance than attractiveness, because dominance is more threatening than
329 attractiveness in the context of a male rival, and therefore we would predict interactions
330 between gender and attractiveness, and gender and dominance (Dijkstra and Buunk, 1998,
331 p.1159).

332 It is not easy to explain the discrepancies between our findings and the findings of the
333 original paper. Our manipulation checks demonstrated that our attractiveness and
334 dominance manipulations affected the participants as intended, and our sample size was over
335 twice that of the original. We do not have particular reason to believe that our participant
336 sample differed sufficiently from the original to lead to the differences; Dijkstra and Buunk
337 (1998) recruited undergraduates from a university in the Netherlands, while we focussed our
338 recruitment around a UK university (just over half of our participants were students), and
339 we recruited participants with a mean age of 22 years. Dijkstra and Buunk (1998) state that
340 the well-known Netherlandic culture of sexual equality makes that country a particularly
341 rigorous test of male/female differences in jealousy, implying that men and women outside
342 the Netherlands may be more likely to differ in the jealousy provoked by different rival
343 characteristics. Although it is not necessarily borne out empirically that male / female
344 differences are greater in non-egalitarian cultures (e.g., Buunk and Dijkstra, 2015), this
345 statement does imply that we should not explain away our null findings based on that the
346 data were collected outside the Netherlands. The original study took place two decades prior
347 to our replication, and it is possible that a cultural shift or difference could explain the
348 discrepant results; perhaps flirting is considered less consequential in our cohort, and so less
349 likely to have serious ramifications. One other possible contributor to the failed replication is
350 our stimuli photographs: the original photographs were not available, and so we used other
351 stimuli that we matched approximately to the original in terms of rated attractiveness, but
352 differed from the originals in other ways, including in particular ethnicity. We also fell short

353 of our sample target. Accordingly, to try to verify our findings, we carried out a further
354 replication.

355 **Study 2.**

356 **Participants**

357 Participants were recruited from an online crowd-sourcing website (www.prolific.ac)
358 (Palan & Schitter, 2018). We aimed at a minimum sample 2.5 times the size of the original
359 study ($152 \times 2.5 = N$ of 380), following Simonsohn (2015). The study was only advertised to
360 potential participants who stated, when they enrolled with the crowd-sourcing website, that
361 they were heterosexual students. Participants were paid £1 for their contribution to the
362 study, leading to $N=404$. This sample was supplemented with a small online sample who
363 were recruited via social media and word of mouth ($N=52$). We merged both samples for
364 analyses ($N=456$, 278 women). The majority were current students (81%) and in a
365 relationship (61%). The mean age was 23.34 years ($SD = 4.10$ years, range = 18 - 56 years).

366 **Materials**

367 The materials followed Study 1, with the minor exceptions described below. We no
368 longer included the Inclusion of Others in Self Scale (IoS).

369 **Jealousy scenario.** The scenario was the same as Study 1 and Dijkstra and Buunk
370 (1998).

371 **Dominance manipulation.** The only deviation from Study 1 was that the vignette
372 referred to “University” rather than the specific university named in Study 1.

373 **Attractiveness manipulation via photos.** We used photos from the Radboud
374 Faces Database (Langner et al., 2010), which provides standardised photos pre-rated for
375 attractiveness on a five point scale. We converted the ratings to a seven point scale so that
376 ratings were comparable to those used in the original study, and selected faces so that the
377 high- and low-attractiveness faces differed identically between the genders. The stimuli
378 selected were all White and had a neutral expression
379 (Rafd090_21_Caucasian_male_neutral_frontal.jpg,
380 Rafd090_22_Caucasian_female_neutral_frontal.jpg,
381 Rafd090_30_Caucasian_male_neutral_frontal.jpg,
382 Rafd090_37_Caucasian_female_neutral_frontal.jpg). Crucially, the difference between the
383 unattractive and attractive photos was identical (2.38 points on the 7 point scale) for men
384 (mean ratings of 5.3 and 2.9) and women (mean ratings of 4.9 and 2.5). Further details can
385 be found on the Open Science Framework
386 (https://osf.io/wd7zv/?view_only=6cd0b8ac87344a10a785a693b4041c12).

387 **Mate value.** The six items formed a highly reliable scale (Cronbach's $\alpha = .91$;
388 95%CI: .89 to .92).

389 Procedure

390 The procedure was the same as Study 1, with the exception that we no longer included
391 the Inclusion of Others in Self Scale (IoS), and that different populations were recruited.

392 Results

393 Manipulation checks

394 **Attractiveness.** Replicating Dijkstra and Buunk (1998), a 2 x 2 ANOVA (high vs
395 low rival attractiveness; high vs low rival dominance) on men's ratings revealed a significant
396 main effect of manipulated on perceived rival attractiveness, $F(1, 174) = 88.88, p < .0001,$
397 $\eta_g^2 = .34$. Men rated the attractive rival as more attractive ($M = 4.06, SD = 1.18,$ original M
398 $= 2.59$) than the unattractive rival ($M = 5.52, SD = .96,$ original $M = 4.92$). Dominant
399 rivals were also perceived as more attractive, $F(1, 174) = 15.86, p < .001, \eta_g^2 = .08,$ although
400 this effect was more than 4 times smaller than the effect of attractiveness on perceived
401 attractiveness. The interaction was not statistically significant, $F(1, 174) = 0.36, p = .547,$
402 $\eta_g^2 < .01$. Similarly, we found that in the male sample a 2 (rival physical attractiveness) x 2
403 (rival dominance) ANOVA on perceived rival attractiveness compared to oneself, supported a
404 significant main effect of the attractiveness manipulation, $F(1, 174) = 31.99, p < .001, \eta_g^2 =$
405 $.16,$ and a main effect of the dominance manipulation, $F(1, 174) = 7.64, p = .006, \eta_g^2 = .04.$
406 The interaction effect was not statistically significant, $F(1, 174) = 0.89, p = .348, \eta_g^2 < .01.$
407 Again, the effect was roughly fourfold for the attractiveness manipulation as opposed to the
408 dominance manipulation. Thus, we can conclude that the manipulation was successful: men
409 rated the attractive rival as more attractive compared to themselves ($M = 4.23, SD = 1.41,$
410 original study: $M = 2.82$) than the unattractive rival ($M = 5.40, SD = 1.41,$ original study:
411 $M = 5.61$).

412 The manipulation checks similarly supported a successful manipulation of rival
413 physical attractiveness on women's ratings. In the two corresponding 2 x 2 ANOVAs there
414 was a statistically significant main effect of photograph attractiveness, $F(1, 274) = 67.13, p$
415 $< .0001, \eta_g^2 = .20$ and $F(1, 274) = 26.43, p < .0001, \eta_g^2 = .09,$ respectively. Women rated the
416 attractive rival as more attractive ($M = 3.62, SD = 1.38,$ original $M = 2.40$) than the
417 unattractive rival ($M = 4.94, SD = 1.30,$ original $M = 5.09$). Women also rated the
418 attractive rival as more attractive in comparison to themselves ($M = 4.22, SD = 1.50,$
419 original $M = 2.81$) than the unattractive rival ($M = 5.12, SD = 1.45,$ original $M = 5.61$). In
420 the 2 x 2 ANOVA on attractiveness in comparison to oneself, there was also a significant

421 interaction between rival attractiveness and rival dominance, $F(1, 274) = 6.29, p = .013, \eta_g^2$
422 $= .02$, but this effect was roughly a quarter of the size of the main effect of attractiveness.
423 Taken together, this suggests that we successfully manipulated rival attractiveness for the
424 female participants.

425 **Dominance.** For men, a 2 x 2 MANOVA showed a significant effect of the
426 dominance manipulation on ratings of the six rival dominance traits (Pillai's Trace= .28,
427 $F(6,169) = 11.07, p < .0001$). All of the univariate F -tests showed a statistically significant
428 effect for dominance of the rival (All F 's (1,174) > 19 , all p 's $< .0001$). Similarly, for women,
429 the 2 x 2 MANOVA supported the successful manipulation of dominance for all six ratings
430 (Pillai's Trace= .40, $F(6,269) = 29.53, p < .0001$). All of the univariate F -tests showed a
431 statistically significant effect for dominance of the rival (All F 's (1,276) > 49 , all p 's $< .0001$).

432 The 2 x 2 MANOVA in men also showed a significant effect of rival attractiveness on
433 ratings of the six dominance traits (Pillai's Trace= .07, $F(6,169) = 11.07, p = .035$). This is
434 similar to the result reported by Dijkstra and Buunk ($F(6,65) = 2.33, p=.05$). Note that the
435 effect of dominance is four times the size of that of attractiveness (Pillai's Trace= .28
436 vs. Pillai's Trace= .07). The follow-up ANOVAs showed a statistically significant effect of
437 attractiveness on ratings of assertiveness, self-confidence, extroversion, social competence
438 (All F 's (1,174) > 4.5 , all p 's $< .05$), but no statistically significant effect on ratings of
439 "being a good judge of character" ($F(1,174) = 0.18, p = .668$) and on ratings of influence (
440 $F(1,174) = 3.32, p = .070$). Unlike men, and unlike Study 1 and Dijkstra and Buunk (1998),
441 we found no significant effect of rival attractiveness on ratings of the six dominance traits in
442 the 2 x 2 MANOVA (Pillai's Trace= .03, $F(6,269) = .07, p = .167$).

443 **Mate value.** Unlike Study 1, women ($M = 24.39, SD = 7.99$) reported a
444 significantly higher self-reported mate value than men ($M = 22.63, SD = 7.6$), $t(391.19) =$
445 $2.36, p=.019$, Cohen's $D = 0.22$, 95% CI [0.03, 0.41], of small effect size. Inclusion of a
446 covariate could lead to issues (Schneider et al., 2015) and given that the effect was small,

447 and in order to maintain consistency with Study 1, we did not include the covariate in our
448 ANOVA design. Including mate value as a covariate in the 2 x 2 x 2 ANOVA leads to similar
449 conclusions as those described below (none of the effects were statistically significant, all p 's
450 $> .19$, analyses described in full in the analysis document on the OSF).

451 Hypothesis tests

452 **2 (rival physical attractiveness) x 2 (rival dominance) x 2 (gender)**
453 **ANOVA: effects on jealousy ratings.** Figure 4 presents the histograms by condition
454 for men and women.

455 **Please insert Figure 4 here.**

456 In line with Study 1, but unlike Dijkstra and Buunk (1998), the proposed 2 x 2 x 2
457 interaction was not statistically significant, $F(1, 448) = 0.42, p = .518, \eta_g^2 < .01$. Contrary to
458 both Study 1 and Dijkstra and Buunk (1998), there was no statistical evidence for the
459 hypothesized Gender*Attractiveness interaction on jealousy, $F(1, 448) = 1.23, p = .268, \eta_g^2$
460 $< .01$. There was also no support for a Gender*Dominance interaction, $F(1, 448) = 0.15, p$
461 $= .694, \eta_g^2 < .01$. No other effects were statistically significant (all p 's $> .29$).

462 **Analyses of jealousy by gender.** Figures 5 and 6 show the effects by gender in
463 comparison to the original study. For men, a 2 (rival physical attractiveness) x 2 (rival
464 dominance) ANOVA, showed no significant main effects of attractiveness or dominance on
465 jealousy, nor an interaction (all F 's < 1.1 , all p 's $> .3$). Similarly, for women a 2 (rival
466 physical attractiveness) x 2 (rival dominance) ANOVA showed no significant effects (all F 's
467 < 1.85 , all p 's $> .17$).

468 **Please insert Figures 5-6 here.**

Discussion

469

470 None of the analyses supported the hypothesised interaction effects. Given that we
471 were left with mixed findings, we conducted a meta-analysis of Study 1, Study 2, and all of
472 the relevant published findings that we could locate, in order to provide synthesis. Our
473 meta-analysis additionally allowed us to include leave-one-out analyses (see supplementary
474 materials on the OSF) to confirm that results were robust to the exclusion of individual
475 studies.

Meta-analytic synthesis

476

477 We searched Web of Science and located 198 papers that used the term “jealousy”,
478 plus either “partner” or “rival”, plus either “trait” or “characteristic” or “attribute” or
479 “quality” or “feature” (and variants of those words, such as “traits”). We also obtained 27
480 candidate papers via Google Scholar (as they cited Dijkstra & Buunk, 1998 or similar
481 papers). After excluding duplicates and screening, 16 of these papers were deemed relevant
482 (description of criteria [here](#)), and 15 yielded usable effect sizes (no effect size derivation
483 possible for Nadler & Dotan, 1992). Of the 22 samples that we used (see Figure 7), five
484 specified that participants were exclusively heterosexual and none focussed exclusively on
485 non-heterosexual participants; 17 used samples whose mean age was <26 years, 3 used
486 samples whose mean age was > 26, and 2 did not provide participant ages; 15 used student
487 (or majority student) participants and 6 did not (1 unspecified); 4 samples were collected
488 within the USA while the remainder were based outside the USA.

489 We converted the usable effect sizes to Pearson correlations, and then applied Fisher’s
490 r to z transformation. We then conducted random effects meta-analyses with REML
491 estimation via the metafor package in R to examine how men’s and women’s jealousy was
492 affected by rival attractiveness and rival dominance (Viechtbauer, 2010, 2015). All details,

493 including additional tests and checks (e.g., funnel plots and leave-one-out analyses), can be
494 found on the [OSF](#).

495 Meta-analysis supported a weak effect for a gender difference in how rival attractiveness
496 affected jealousy ($k = 22$ samples encompassing 5,899 participants, $r = 0.22$, 95%CI [0.15,
497 0.3], Figure 7). A visual check suggested no evidence of publication bias. There was, however,
498 substantial heterogeneity in the effect, $Q(21) = 194.83$, $p < .0001$, $I^2 = 86.91\%$, $\tau^2 = .026$.

499 In contrast, although notably based upon a smaller sample ($k = 13$ samples
500 encompassing 4,038 participants), there was no support for a gender difference in how social
501 dominance of the rival affected reported jealousy ($r = 0.01$, 95%CI [-0.05, 0.08], Figure 8).
502 Again, a visual check suggested no evidence of publication bias. There was substantial
503 heterogeneity in the effect, $Q(12) = 41.77$, $p < .0001$, $I^2 = 76.15\%$, $\tau^2 = .011$.

504 A reviewer suggested that we conduct meta-regression to further examine the effect of
505 several potential moderators on the effect (e.g., age of participants, study design).
506 Meta-regression is especially likely to yield false positive results when the number of studies
507 is low, there is a large number of potential moderators, and when heterogeneity is present
508 (Higgins & Thompson, 2004). In the absence of strong *a priori* predictions, we therefore did
509 not pursue meta-regressions. This is in line with recommended best practice (e.g., Higgins &
510 Thompson, 2004). Nonetheless, in the General Discussion below, we suggest some candidate
511 moderators, but we believe that these should be explored in line with theoretical motivations,
512 and with a larger number of studies, in a structured, preregistered way, in order to avoid
513 overfitting.

514 We therefore conclude that, all together, there is a small, significant effect of gender on
515 jealousy provoked by rival attractiveness, such that rival attractiveness influences women's
516 reports of jealousy to a greater degree than it influences men's reports. There is no good
517 evidence for a robust gender difference in jealousy responses to rival dominance.

518 **Please insert Figure 7 here.**

519 **Please insert Figure 8 here.**

520 **General discussion**

521 We set out to perform a direct replication of a well-cited study, Dijkstra and Buunk
522 (1998), that found that in a vignette-based scenario where participants imagined their
523 partner being approached by a potential other-sex romantic rival, the men's jealousy
524 appeared to be particularly responsive to the dominance of the male rival, whereas the
525 women's jealousy appeared to be particularly responsive to the attractiveness of the female
526 rival. This male/female difference was predicted based on evolutionary theory regarding the
527 relative importance of dominance and attractiveness to men's and women's appeal as a
528 romantic partner. In two empirical studies plus a meta-analysis that drew from an additional
529 15 published papers sampling nearly 6,000 participants, we found some evidence that the
530 attractiveness of a female rival provoked women's jealousy, and did so to a greater extent
531 than it did men's, but the overall effect size was small, and the published findings
532 demonstrated substantial heterogeneity. The subset of the papers (13 samples; over 4,000
533 participants) that focussed on a male rival's dominance provided no good evidence that this
534 affected men's jealousy; again, findings across the literature were heterogeneous, as is typical
535 for psychology (e.g., Kenny & Judd, 2019). The heterogeneity in effect sizes implies firstly
536 that we should treat estimates of the average average effect size with caution, and secondly
537 that we might better understand the phenomenon under investigation if we explore the
538 sociocultural or methodological influences that contribute to the variability in the size of the
539 difference between men and women.

540 There are two principal design limitations that might help explain why studies in this
541 area do not consistently find gender differences in jealousy. The first is the use of vignettes,

542 which allow researchers to simulate the topic of interest, but of course lack the depth and
543 immersion of real life (Hughes & Huby, 2002). The vignette's description, of the apparent
544 rapid escalation of a nascent romantic attraction between a stranger and someone in a
545 relationship, may not feel realistic for many participants. A textual manipulation might
546 additionally lack realism for contemporary samples who would be more used to today's
547 regular exposure to interactive media. If this is the case, the vignettes might have been
548 ineffective in provoking jealousy in some samples, and thus inadequate to robustly provoke
549 different levels of jealousy between men and women, leading to null findings. The second
550 limitation is the use of simple pseudoreplication in stimuli, a problematic design whereby
551 hypotheses about a class of stimuli are tested using just one (or a few) exemplar(s) (e.g.,
552 Hurlbert, 1984; Kroodsma, Byers, Goodale, Johnson, & Liu, 2001; Wells & Windschitl,
553 1999). Thus, following the design of the study that we sought to replication, our study
554 design used just one stimulus to represent each of the high-dominance and low-dominance
555 rivals, and just one male and one female photograph to represent each of the attractive and
556 less attractive rivals. Even given our successful manipulation checks, the stimuli could have
557 been inadequate as a solid representation of their class of stimuli. As a specific example of
558 how this could be problematic, attractiveness is associated with a whole range of different
559 parameters (e.g., symmetry, averageness, femininity, and apparent health; Rhodes, 2006)
560 which would be represented to different degrees in the different stimuli used, and it is
561 conceivable that differences in these parameters could mean that the different stimuli used in
562 different studies agitate jealousy to greater or lesser extents, even if they are sufficient to
563 pass the manipulation checks. Further, it is possible that the hypothesised effects were not
564 readily apparent in our replication studies because our participants were insufficiently
565 motivated or engaged. However, our participants were drawn from standard sources of
566 psychological data. Our participants, unlike those of the original study, were predominantly
567 sourced online. Although early critiques of online studies expressed concerns about lack of
568 quality control over the data, several studies have indicated that we do not need to have

569 prima facie concerns that online studies are less reliable than offline studies [Krantz, Ballard,
570 and Scher (1997)}, and indeed online studies benefit from being able to reach large sample
571 sizes (Birnbaum, 2004; Epstein, Klinkenberg, Wiley, & McKinley, 2001; Krantz & Dalal,
572 2000), which can offset any increased noise in the data.

573 A productive direction for future research might be to consider the boundaries of any
574 effect: do rival characteristics shape jealousy in friendships, or sibling rivalries, for instance?
575 The conventional study design on (heterosexual) male / female differences in responses to
576 rival characteristics presents a perfect confound between rater and rival gender: men judge
577 male rivals, whereas women judge female rivals. This design does not allow us to rule out the
578 possibility that the presumed domain-specific responses to rivals arise because men and
579 women place difference emphasis on dominance and attractiveness in judging others in all or
580 many contexts. Indeed, differences in men's and women's use of the scales, or understanding
581 of the concepts of attractiveness and dominance, could also add noise to the data (see
582 Edlund and Sagarin (2009) for discussion). Future research might also look beyond WEIRD
583 populations (Western, Educated, Industrialized, Rich, Democratic, Henrich, Heine, &
584 Norenzayan, 2010; Pollet & Saxton, 2019). We made use of a WEIRD sample, which was
585 important to ensure compatibility with the original paper, but we should not assume the
586 cross-cultural invariance of our findings. We believe that our results would be reproducible
587 within other cohorts of young adults in western populations, who have at least some
588 experience of romantic relationships. The appropriateness of the stimuli for the participants
589 is also likely to be a key predictor of the success of the manipulation: for instance, whether
590 the scenario in the vignette seems realistic to participants, and whether the images used to
591 manipulate attractiveness of the rivals are suitable (e.g. in terms of age). We might expect
592 different patterns of responses to rival characteristics in homosexual participants (Buunk &
593 Dijkstra, 2001), or when people are focussed on exclusively sexual infidelity without elements
594 of emotional infidelity (Buunk & Dijkstra, 2004).

595 What do our results have to say about the impact of rival characteristics in jealousy?
596 We do not doubt that individuals could be more or less intimidating as rivals, contingent
597 upon their characteristics, including, in many circumstances, their dominance and
598 attractiveness. However, our findings indicate that dominance, and even to some extent
599 attractiveness, are not rival characteristics that distinguish men's and women's jealousy both
600 reliably and substantially. This is perhaps not surprising, taken in the round. First, adults
601 with established romantic relationships might adjust their jealousy based more upon their
602 perceptions of the stability of their relationship, and the nature of their partner, than upon
603 the characteristics of an abstract rival. They might also have a more precise idea of exactly
604 which characteristics are considered particularly beguiling by their partner, and whether
605 those characteristics are represented by the stimuli used or not. Second, the original study
606 argues for women's attraction to dominance on the basis that dominance relates to resource
607 provision (Dijkstra & Buunk 1998, p.1158). While resource provision has been robustly
608 demonstrated to be especially appealing to women (e.g., Buss (1989)), dominance (or,
609 indeed, the set of traits manipulated by the vignette) is one step removed. Finally, there are
610 also relevant individual differences that will interact with the stimuli, including the features
611 that people find physically attractive (e.g., Lee, Dubbs, Hippel, Brooks, & Zietsch, 2014),
612 and the extent to which women seek dominance (or related constructs) in a partner (e.g.,
613 Lukaszewski & Roney, 2009). Overall, we conclude that the attractiveness and dominance of
614 potential rivals are certainly characteristics that can be weighted in judging a rival's threat,
615 but the threat potential of those characteristics depends upon much more than gender.

616

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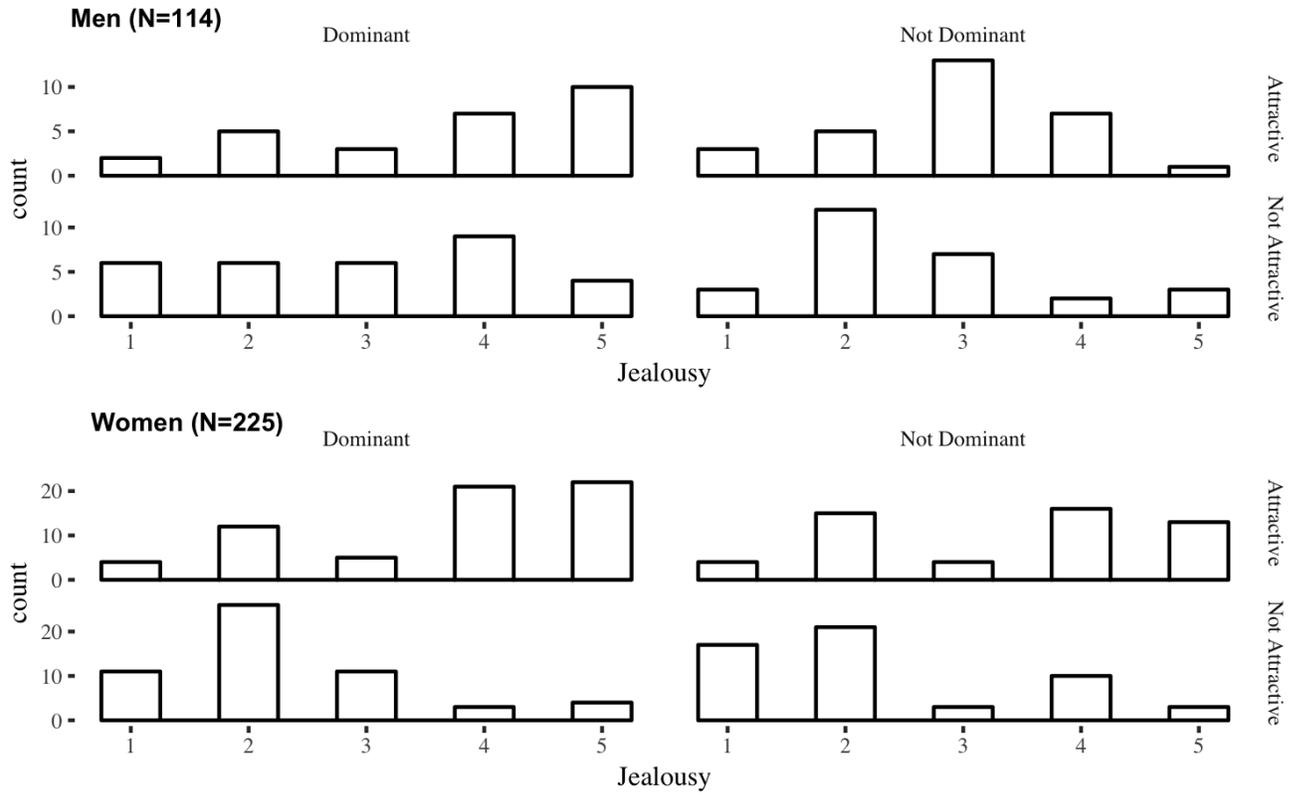


Figure 1. Histogram of number of male (top) and female (bottom) participants who gave each jealousy rating, separated by rival dominance (left and right set of graphs) and rival attractiveness (upper and lower graphs in each pair) (Study 1).

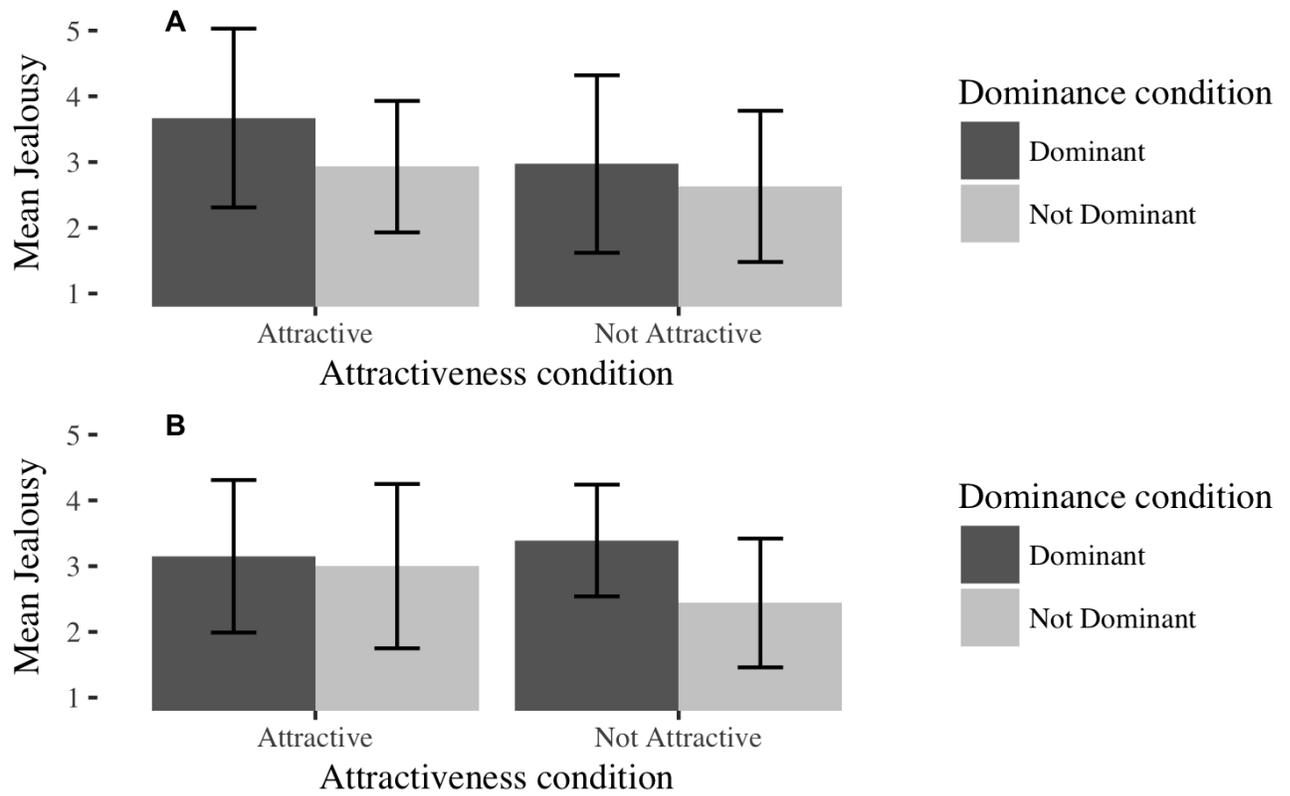


Figure 2. Bar chart of men’s jealousy separated by rival dominance and rival attractiveness, for Study 1 (A) and Dijkstra and Buunk (1998) (B). Error bars are Standard Deviations (SD).

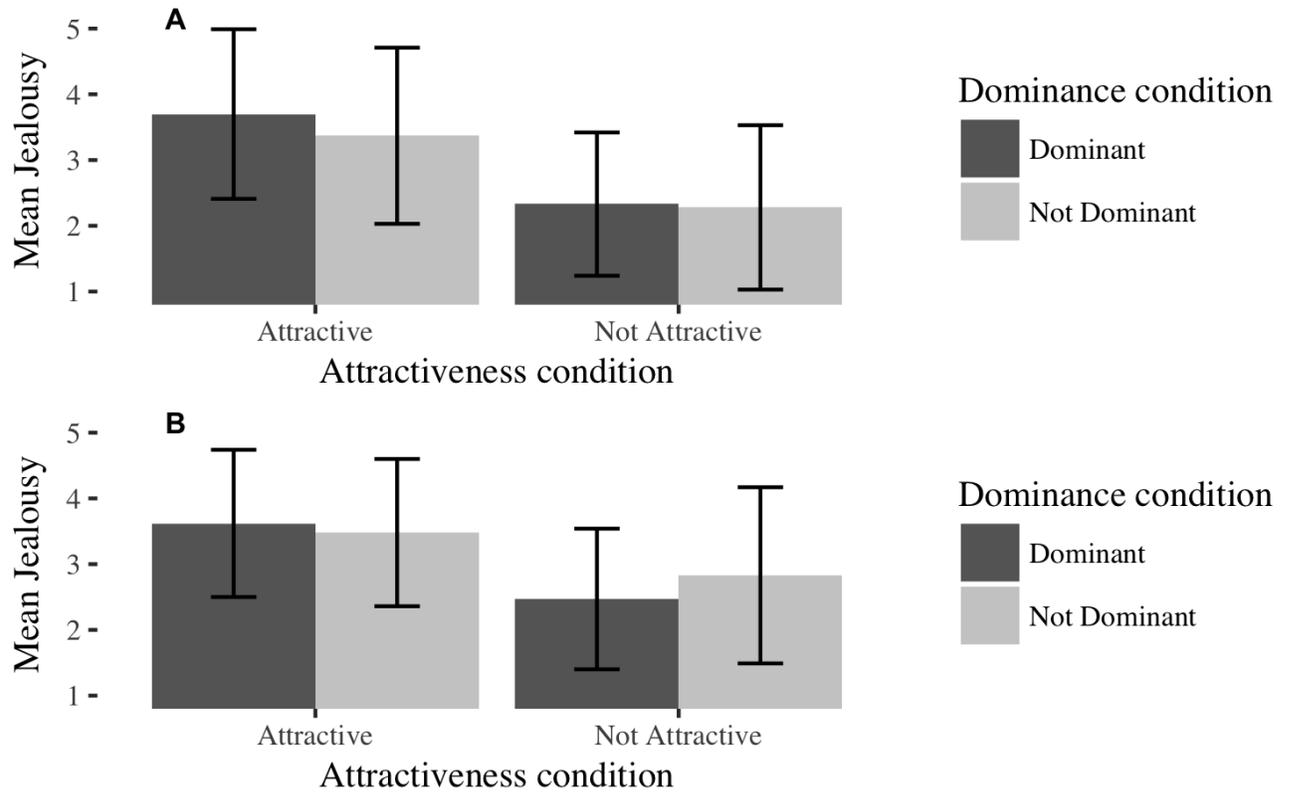


Figure 3. Bar chart of women’s jealousy separated by rival dominance and rival attractiveness, for Study 1 (A) and Dijkstra and Buunk (1998) (B). Error bars are Standard Deviations (SD).

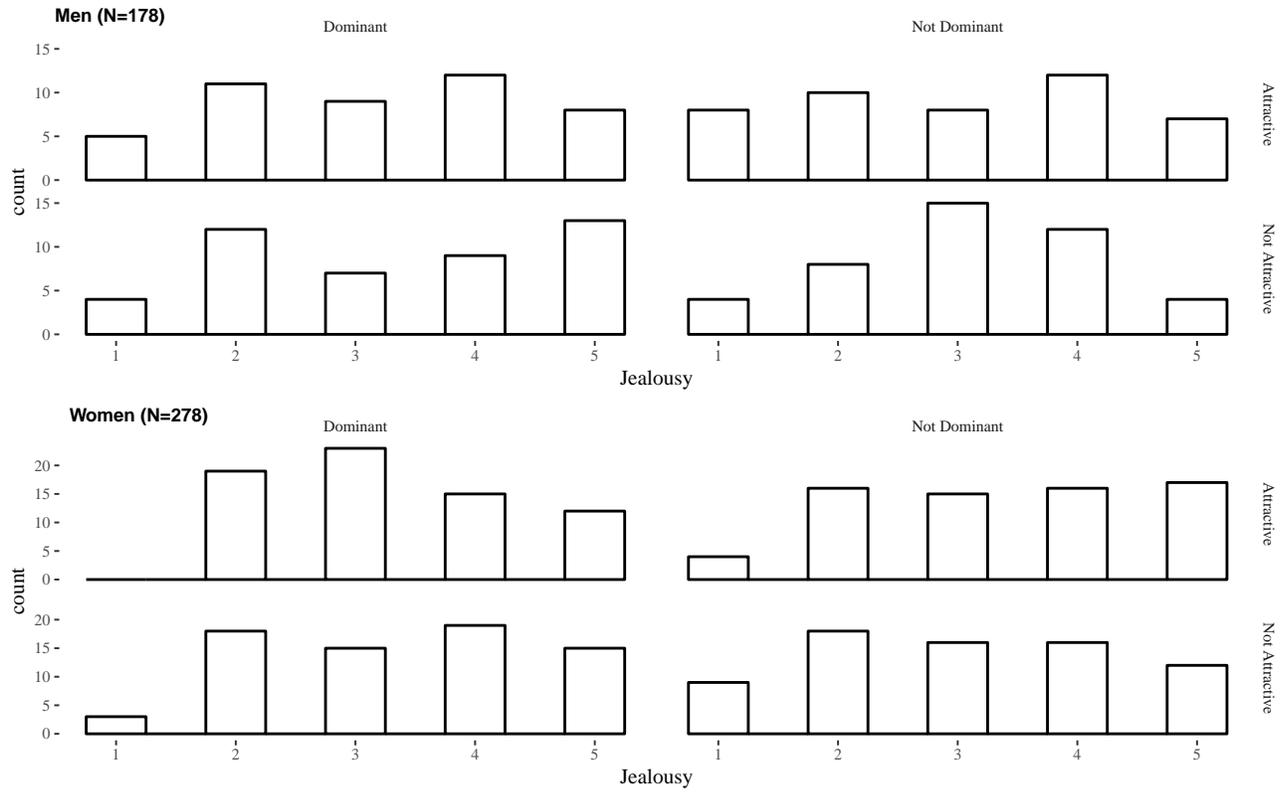


Figure 4. Histogram of number of male and female participants who gave each jealousy rating, separated by rival dominance and rival attractiveness (Study 2).

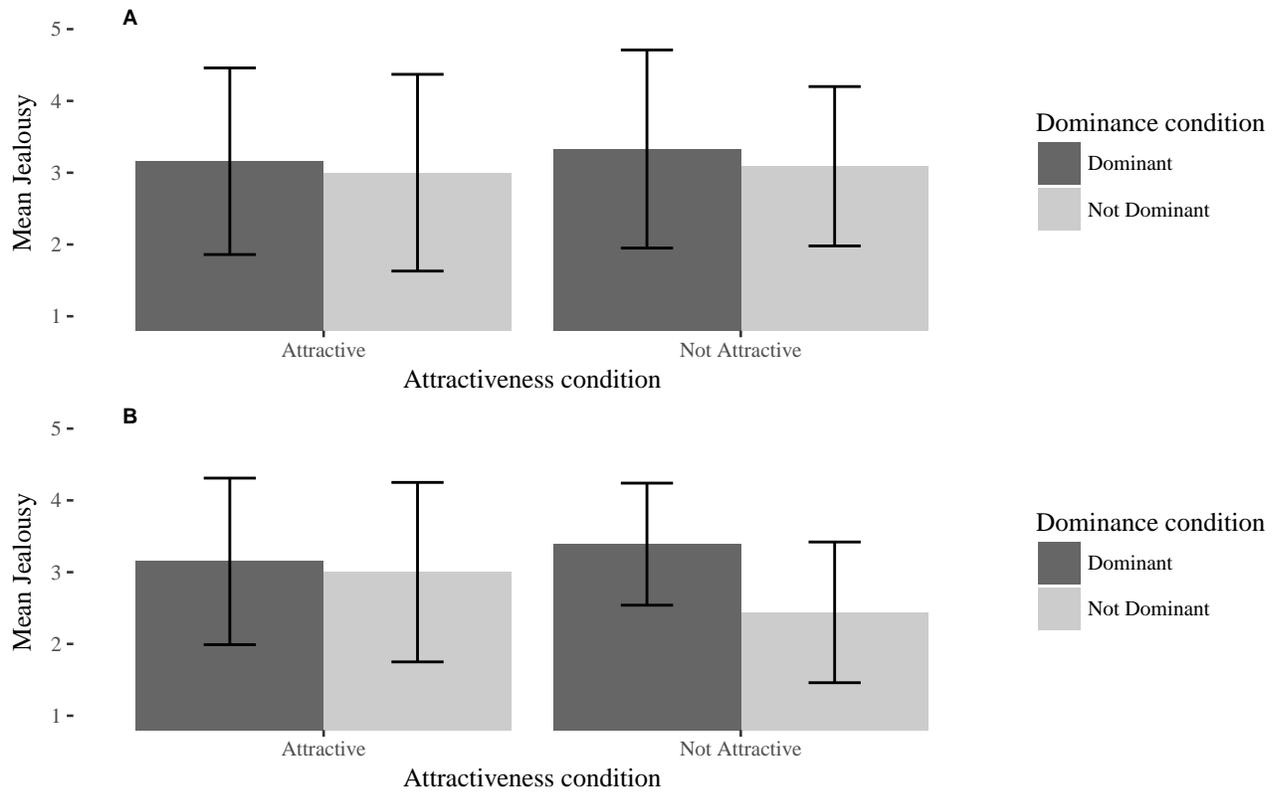


Figure 5. Bar chart of men’s jealousy separated by rival dominance and rival attractiveness, for Study 2 (A) and Dijkstra and Buunk (1998) (B). Error bars are Standard Deviations (SD).

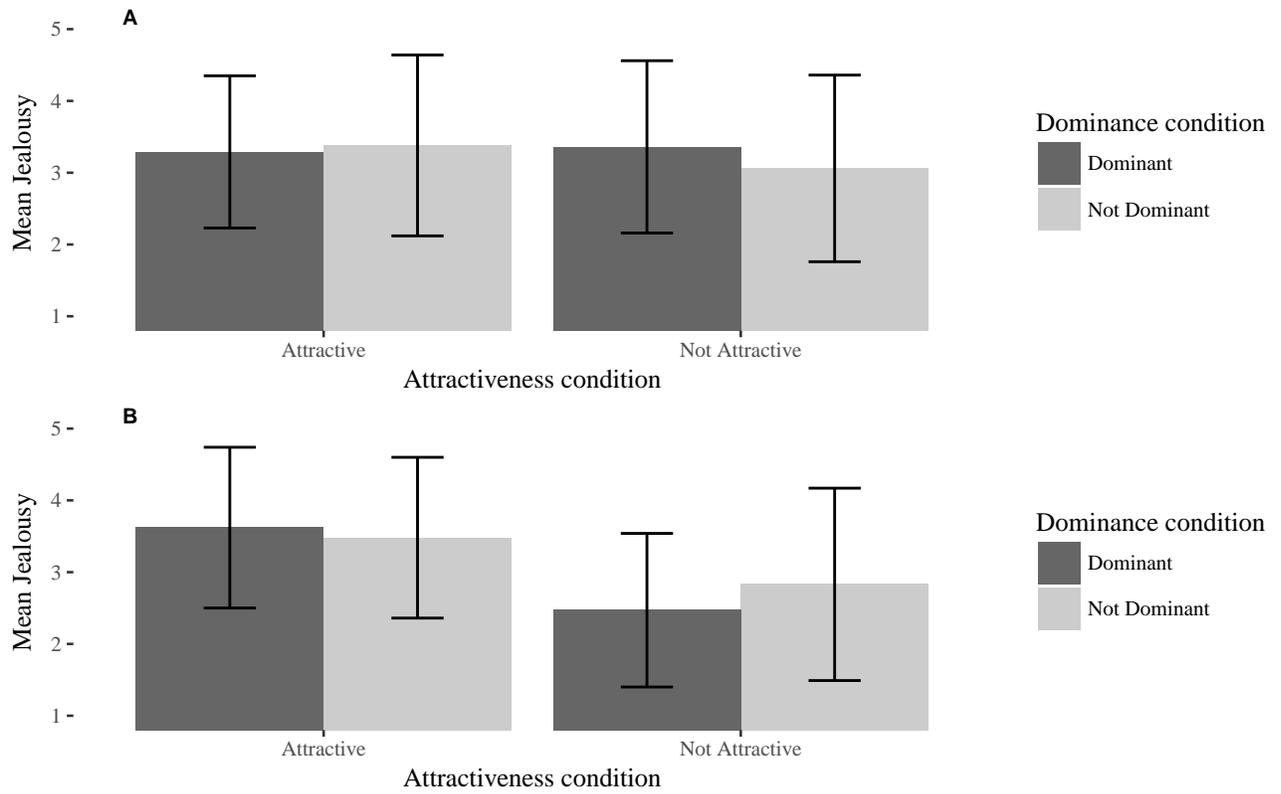


Figure 6. Bar chart of women’s jealousy separated by rival dominance and rival attractiveness, for Study 1 (A) and Dijkstra and Buunk (1998) (B). Error bars are Standard Deviations (SD).

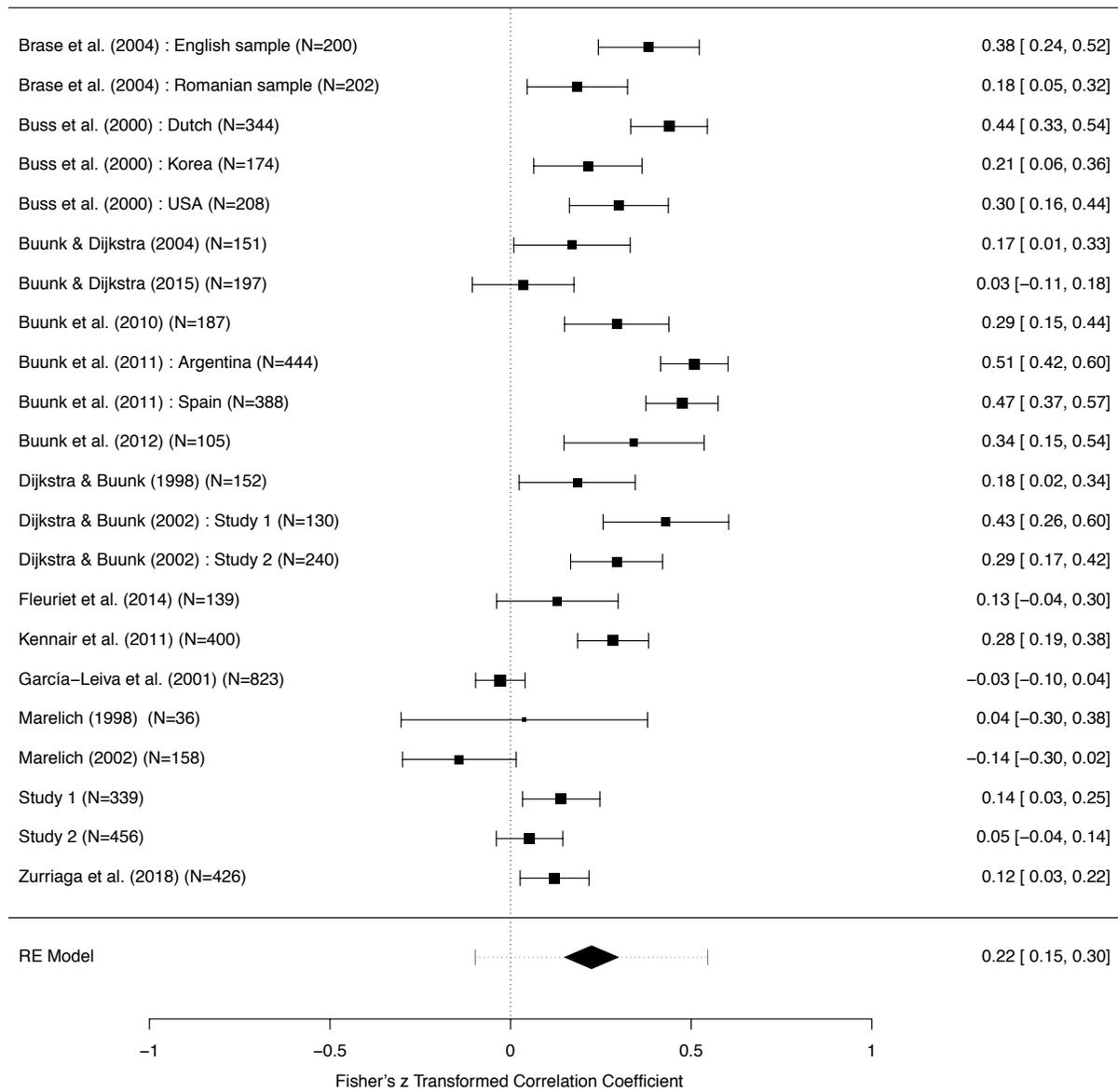


Figure 7. Forest plot (effects and 95% CI) for gender differences in the effect of rival attractiveness on jealousy Note that the dashed interval for the Random Effects model is the prediction interval.

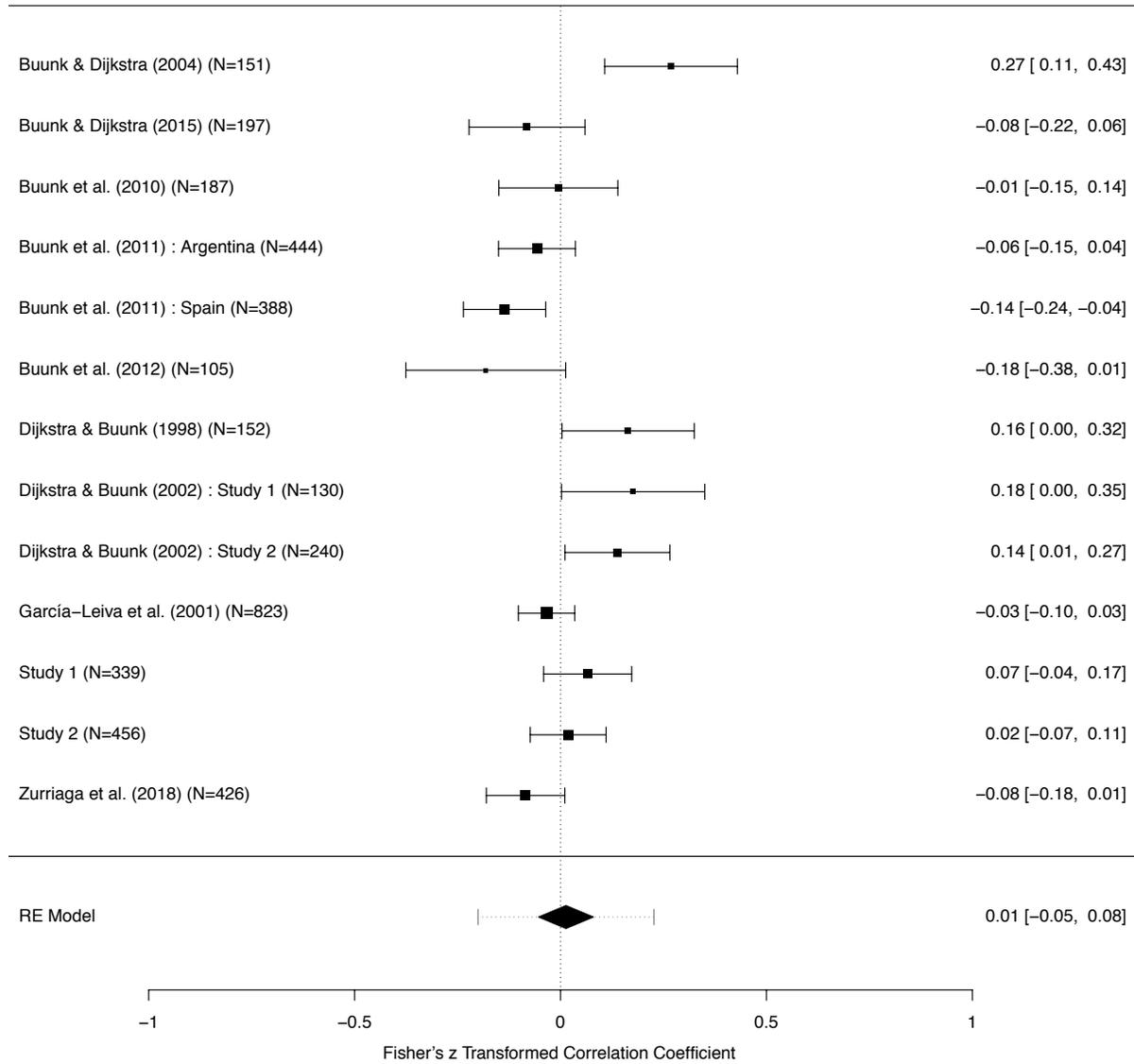


Figure 8. Forest plot (effects and 95% CI) for gender differences in the effect of rival dominance on jealousy. Note that the dashed interval for the Random Effects model is the prediction interval.