

Men say "I love you" before women do: robust across several countries

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1 **MEN SAY “I LOVE YOU” BEFORE WOMEN DO: ROBUST ACROSS SEVERAL**
2 **COUNTRIES**

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28 **ABSTRACT**

29 Feeling and expressing love is at the core of romantic relationships, but individuals differ in
30 their proclivity to worry about their relationships and/or avoid intimacy. Saying ‘I love you’
31 signals a commitment to a future with our romantic partner. Contrary to gender stereotypes,
32 research in the US demonstrates that men are more likely to confess love first. We aimed to
33 replicate this sex difference in an online cross-national sample (seven countries, three
34 continents), while testing for variation according to attachment style and environment (the
35 national sex ratio). Men were more likely to confess love first in a relationship, with
36 preliminary evidence that this was more likely when men had more choice (more female-
37 biased sex ratio). Independent of biological sex, highly avoidant respondents were less happy
38 to hear ‘I love you’ than less avoidant respondents, and highly anxious respondents were
39 happier to hear ‘I love you’ than less anxious respondents. Our findings suggest that prior
40 observations generalize beyond an ethnically homogenous sample, and incorporate
41 attachment theory into the study of love confessions. Our research suggests a dissociation
42 between initial declarations of love (moderated by biological sex) and emotional responses to
43 love confessions, moderated by attachment style but not by biological sex.

44 **Key words:** Close relationships, Sex differences, Speech acts, Sex ratio, Attachment,
45 Affectionate communication, Error Management Theory

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46 **MAIN BODY**

47 **INTRODUCTION**

48 **Expressing love and the male confession bias**

49 Romantic love and passion are cultural universals (Jankowiak, 2008) and the need to
50 feel belonging within stable social relationships is ubiquitous (Baumeister & Leary, 1995).
51 The feeling of love predicts desire, sympathy, and commitment by facilitating trust and
52 improving how couples resolve conflict (Gonzaga, Keltner, Londahl, & Smith, 2001).
53 Commitment, in turn, both predicts and causes forgiveness in relationships (Finkel, Rusbult,
54 Kumashiro, & Hannon, 2002) and lowers anxiety in response to stress when we feel
55 supported (Collins & Feeney, 2013; Ditzen et al., 2008). Moreover, expressions of love and
56 acts of affection enhance commitment (Joel, Gordon, Impett, MacDonald, & Keltner, 2013;
57 Marston, Hecht, Manke, McDaniel, & Reeder, 1998) and predict stable marital bonds
58 (Huston, Caughlin, Houts, Smith, & George, 2001). In sum, both the emotion and expression
59 of romantic love contribute to stable long-term relationships and positive health outcomes
60 (see also Cacioppo, Cacioppo, Capitanio, & Cole, 2015; Foran, Whisman, & Beach, 2015;
61 Whisman & South, 2017 for discussion).

62 While the emotion and expression of romantic love underpins good quality
63 relationships, individuals differ in their proclivity toward romantic love, and such differences
64 may be revealed in speech acts. Saying 'I love you' signals commitment to future behavior
65 with a romantic partner (Ackerman, Griskevicius, & Li, 2011). Extensive research on
66 evolutionary approaches to behavior within romantic relationships has revealed differences
67 between men and women in mating-related preferences, cognitions, and behaviors, which
68 may have implications for how heterosexual relationships function at various stages (see Buss
69 & Schmitt, 2019 for a recent review). Many of these studies have used self-report methods to
70 test hypotheses generated from evolutionary theories and observations across diverse cultures

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71 and species. Moreover, within this field, robust findings from self-report data converge with
72 experimental tests, among other diverse methods (see Buss & Schmitt, 2019 for a recent
73 review), consistent with the importance of triangulation in science (Munafò & Davey Smith,
74 2018). Research on sex differences around mating has developed, in part, based on two key
75 theories: parental investment theory of mate choice (Janicke, Haderer, Lajeunesse, & Anthes,
76 2016; Todd, Penke, Fasolo, & Lenton, 2007; Trivers, 1972) and Error Management Theories
77 of human perception and cognition (Haselton & Buss, 2000; Haselton & Nettle, 2006;
78 Johnson, Blumstein, Fowler, & Haselton, 2013). The current paper and the research we
79 attempt to replicate (Ackerman et al., 2011) also draws from these two theories. Error
80 Management Theory proposes that because decision making under uncertainty can lead to
81 error, human perception and cognition has evolved to pursue the least costly of two opposite
82 strategies in contexts related to survival or reproductive fitness. While false positive errors
83 are favored (i.e., ‘optimism’) in contexts where it is less costly to think/act/speak than to not
84 do so, false negative errors (i.e., ‘caution’) are favored in contexts where it is less costly,
85 from an evolutionary perspective, to avoid that same behavior than to engage in it. Because
86 speech acts such as love confessions are made under a degree of uncertainty and are
87 associated with non-trivial costs and benefits (e.g., backfire in the attempt to escalate the
88 level of commitment), particularly when communicated for the first time, they too can be
89 studied via this framework.

90 According to biological theories on parental investment, the more investing and
91 ‘selective’ sex would value signals of commitment more than the other, less investing, sex,
92 particularly in light of the long period of parental investment required for our species (see
93 Lawson & Mace, 2011 for discussion). Due to both biological (pregnancy and lactation) and
94 societal factors, women generally invest more heavily in children than men. Therefore,
95 following this theory and empirical evidence for sex differences in mating-related cognition

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96 and behaviors (e.g., Haselton & Buss, 2000; Janicke, Haderer, Lajeunesse, & Anthes, 2016;
97 Todd, Penke, Fasolo, & Lenton, 2007) that are consistent with an error management
98 framework (i.e., relatively cautious females and optimistic males, Haselton & Buss, 2000),
99 women could avoid the greater costs of a potential poor mate choice by setting a relatively
100 higher threshold than men do in displaying commitment or investment, all else equal.
101 Consistent with this proposal, American men, on average, are more likely than American
102 women to say “I love you” first in a romantic relationship (the ‘male confession bias’), and
103 are happier than women to hear their partner confess love, particularly if this is
104 communicated before the couple has engaged in sexual intimacy within their relationship
105 (Ackerman et al., 2011). This earlier male confession may function to escalate sexual
106 intimacy within the relationship in light of the stronger relative importance of men
107 communicating commitment to women than vice-versa, all else equal (Ackerman et al.,
108 2011).

109 Replication of this effect across cultures is important as it allows us to infer whether
110 prior observations are universal or generalizable (see, e.g., Pollet & Saxton, 2019 for a recent
111 discussion). Romantic love is a cultural universal (Jankowiak, 2008), but cultures differ in
112 their romantic practices (Hatfield & Rapson, 2005) and gender norms. Moreover, little is
113 known about love confessions as they are normally a private act, which may partly explain
114 why folk beliefs and perceptions differ from observed behaviors when examining who
115 confesses love first (Ackerman et al., 2011). Thus, cross-cultural research on love confessions
116 is needed and can shed light on the utility of evolutionary explanations of this topic if the
117 previously observed sex differences are robust. Indeed, cross-cultural research is central to
118 evolutionary approaches to human behavior, as this field is interested both in patterns that
119 occur at the species level and cultural variations that can be predicted by evolutionary theory.
120 Thus, the current study attempted to replicate and generalize Ackerman and colleagues’

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121 findings for sex differences in confessing love (who confesses first), and other sex differences
122 related to a love confession (happiness at hearing a love confession, days into relationship
123 before: thinking about confessing love, and confessing love), across a larger global sample,
124 while also examining whether this sex difference is consistent across each nation surveyed
125 (Hypothesis #1).

126 **Cultural differences and the male confession bias**

127 Consistency in behaviors across diverse cultures does not rule out systematic variation
128 between cultures in those same behaviors, such as the extent to which they are expressed,
129 driven by the characteristics and demands of a given environment. Thus, we also tested for
130 cultural differences in responses to our survey items, examining whether the timing of a love
131 confession was predicted by the national sex ratio of males to females. Sex ratio theory,
132 corroborated by correlational evidence, suggests that proxies for male investment and female
133 promiscuity are observed, respectively, in ecologies with male-biased versus female-biased
134 sex ratios (reviewed in Del Giudice, 2012). For example, historical data from North America
135 demonstrates that men invested more in pair bonds and children in male-biased regions where
136 women had more ‘bargaining power’ as women were more likely to find a partner than men
137 were (reviewed in Schacht & Smith, 2017). Conversely, female-biased sex ratios are related
138 to greater promiscuity according to psychometric tests in non-western communities (Schacht
139 & Borgerhoff Mulder, 2015). Complementary experimental work demonstrates that men and
140 women shift from sex-typical mating strategies (female monogamy and male promiscuity,
141 Schmitt, 2005) toward the strategy of the opposite-sex when the opposite-sex is scarce, as the
142 latter has more bargaining power (Moss & Maner, 2016). Here, we integrate this theory with
143 the earlier logic on love confessions to make predictions about the extent to which the sex
144 ratio alters the costs versus benefits of confessing love, regardless of the veracity of the
145 speech act (i.e., all else equal). Within the general hypothesis that the male confession bias

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146 varies according to the national sex ratio (Hypothesis #2) we can test two alternate
147 hypotheses, examining the direction of this variation. Evidence that men confess love earlier
148 than women in countries with a more male-biased sex ratio (Hypothesis #2a) would support
149 the proposal that men confess love as part of an unconscious strategy to signal investment
150 potential in light of their environment, because male-male competition is more intense, and
151 investment potential is valued by women, who have greater choice in male-biased
152 environments. Alternatively, evidence that men confess love earlier than women in countries
153 with a more female-biased sex ratio (Hypothesis #2b) would support the proposal that men
154 confess love as part of an unconscious strategy to escalate intimacy (see Ackerman et al.,
155 2011) when their environment permits greater mating opportunities. Tests of these alternate
156 hypotheses can shed initial light on the potential evolutionary dynamics of love confessions
157 in different environments.

158 **Attachment styles and individual differences in the male confession bias**

159 In addition to sex differences in the expression of and emotional response to romantic
160 love, there are some individual differences. Indeed, some people worry a lot about the
161 security of their relationships and others avoid aspects of romantic intimacy, reflecting two
162 insecure attachment styles of anxiousness and avoidance, respectively. The final aim of our
163 cross-cultural study was to incorporate attachment styles into the study of love confessions.
164 Developmental theories of attachment (Bowlby, 1973; see Groh et al., 2017 for a recent
165 review) have been applied extensively to the study of romantic relationship functioning (e.g.,
166 Hazan & Shaver, 1987; Mikulincer & Shaver, 2007) both within and across cultures (see,
167 e.g., Schmitt et al., 2004). Attachment styles predict trust in romantic contexts (Fitzpatrick &
168 Lafontaine, 2017; see also Bartz, Zaki, Bolger, & Ochsner, 2011), closeness (Mikulincer,
169 Shaver, Bar-On, & Ein-Dor, 2010), relationship quality (Nofle & Shaver, 2006), care
170 provision and support seeking (Collins & Feeney, 2000; Feeney & Collins, 2003), and how

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171 we respond to emotional warmth from others (Philipp-Muller & MacDonald 2017), and close
172 contact from our partner (Kim, Feeney, & Jakubiak, 2017). Attachment styles are also related
173 to the expression of concern for the good of our partner (i.e., compassionate love) in both
174 younger and older adult cohorts (Sabey & Rauer, 2017; Sprecher & Fehr, 2011). Collectively,
175 attachment styles are related to a variety of behaviors within romantic relationships.

176 Attachment styles also bias perceptions of our relationship in the present and future
177 (see Dykas & Cassidy, 2011 for a review). For example, attachment styles bias the affective
178 content and written interpretation of events within our relationship (Collins, 1996), how we
179 evaluate our partner's empathy (Simpson et al., 2011), and support from our partner under
180 stress (Collins & Feeney, 2004), and perceive our partner as responsive to our needs (or lack
181 thereof) for trust, intimacy, and independence (Ren, Arriaga, & Mahan, 2017). Indeed,
182 anxiously attached individuals require *more* time, affection, and self-disclosure than secure
183 individuals do before they judge their relationship as 'close', while avoidant individuals
184 require *less* time, affection, and self-disclosure than secure individuals do before they judge
185 their relationship as 'close', which suggests that perceptual mechanisms motivate different
186 approach-avoidance behaviors among insecurely attached individuals (Hudson & Fraley,
187 2017). Collectively, attachment styles underpin how individuals navigate and appraise a
188 romantic relationship, which may explain relationship outcomes (see also Karantzas, Feeney,
189 Goncalves, & McCabe, 2015).

190 In the current study, we examined whether the male confession bias (the tendency to
191 say 'I love you' first/earlier), is moderated by attachment style. Men, on average, have a more
192 avoidant and less anxious attachment style than women (see Del Giudice, 2011 for a meta-
193 analytic review across different nations). Both biological sex and attachment style may
194 therefore play a role in love confessions, as the latter is important in how we appraise our
195 relationship over time. Considering the evolutionary logic behind earlier male confession, we

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196 therefore examined whether attachment style could moderate Ackerman and colleagues'
197 previously observed sex difference. Because attachment styles motivate vigilance to
198 relationship maintenance in different ways (Barbaro, Pham, Shackelford, & Zeigler-Hill,
199 2016), they could alter the perceived costs and benefits of confessing love (escalating or
200 maintaining a relationship) and responding to a confession (i.e., optimistically or cautiously,
201 Haselton & Buss, 2000; Haselton & Nettle, 2006), interacting with the different mating
202 strategies of men and women outlined in Hypothesis #1. Here, we examined whether men
203 confess love earlier than their partners do if the respondent in our study has an insecure
204 attachment style (i.e., anxious or avoidant, Hypothesis #3). We predict that both insecure
205 attachment styles are related to an earlier confession among male respondents. Anxiously
206 attached men would be expected to confess love earlier than their partners do to feel secure
207 about retaining their romantic partner, as anxious attachment is related to hypervigilance to
208 partner rejection (Barbaro et al., 2016), and parental investment theories emphasize the
209 importance of sexual access to selective females for male reproductive fitness. Given the
210 theorised role of love confessions in escalating sexual intimacy (Ackerman et al., 2011),
211 earlier love confession would also represent a strategy for avoidant men to escalate intimacy,
212 as avoidant people require less time to perceive their relationship as 'close' (Hudson &
213 Fraley, 2017). Finally, as error management theories predict greater female skepticism of
214 signals of male commitment (Haselton & Buss, 2000; Haselton & Nettle, 2006; Johnson et
215 al., 2016), anxiously attached women would be predicted to delay a love confession, as
216 anxious people require more time to perceive their relationship as 'close' (Hudson & Fraley,
217 2017), and skepticism of partner commitment (see Ackerman et al., 2011; Johnson et al.,
218 2013 for discussion) may be heightened when women are anxiously attached. We have no *a*
219 *priori* directional hypothesis for female avoidance and the male confession bias.

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220 Thus, in sum, our study tested the following pre-registered hypotheses¹:

221 *Hypothesis # 1.* We will attempt to replicate previously reported sex differences in
222 confessing love, and other behaviors related to a love confession, across a larger global
223 sample, and test for consistency in the ‘male confession bias’ across each nation surveyed via
224 our convenience sampling strategy (see Table 1): Men confess love first in a relationship
225 more often than women do; men are happier than women to hear “I love you”; men think
226 about, and confess love earlier in a relationship than women do.

227 *Hypothesis # 2.* People who live in countries with a more *male*-biased sex ratio will
228 report that men confess love earlier than women (*Hypothesis #2a*). People who live in
229 countries with a more *female*-biased sex ratio will report that men confess love earlier than
230 women (*Hypothesis #2b*).

231 *Hypothesis # 3.* If the respondent in our study has a relatively more insecure
232 attachment style (i.e., anxious or avoidant²), they will be more likely to report that the male in
233 the relationship confessed love earlier than the female did.

234 We also examined potential effects of self-rated attractiveness in one exploratory
235 analysis, as a proxy for ‘mate quality’. Attractiveness may partly explain the timing of a love
236 confession, if more attractive individuals can afford to be choosier/selective in light of our
237 positive orientation toward them (see Maestripieri, Henry, & Nickels 2017 for general
238 discussion). Thus, such individuals may be more likely to delay a love confession.

239

¹ Minor edits made to hypotheses from pre-registered version for clarity, following an earlier round of peer review. For example, due to our recruitment strategy it was never our plan to sample an even number of countries with male- and female-biased sex ratios, thus minor edits made to wording of Hypothesis # 2.

² We had no *a priori* directional prediction for women with an avoidant attachment style

240 **METHOD**241 **Participants**

242 A total of 3109 participants ($M_{\text{age}} = 31.90$ years, $SD = 11.60$ years, 71% women, 26%
243 men, 1% non-binary, 3% did not disclose; 85% heterosexual, 6% homosexual, 5% bisexual,
244 1% other, 3% did not disclose) were recruited to an online study by all authors in their
245 respective countries, via campuses and the wider community, research participant pools,
246 word of mouth, Twitter, academic groups on social media and a press release from the lead
247 author's communications department. The press-release informed readers that we were
248 conducting a global study into romantic expression, but did not mention that we were
249 measuring sex differences or attachment styles. The survey platform did not permit duplicate
250 responses from the same device, and participants were not compensated for their time.

251 All procedures for testing and recruitment were approved via the lead author's Ethics
252 Committee, with our introduction and method sections pre-registered via the Open Science
253 Framework after data collection but before data analysis (<https://osf.io/hsvx9/>). Participants
254 provided informed consent after reading an information sheet describing the contents of the
255 survey. We excluded participants who i) reported being less than 18 years old, ii) did not
256 report their sex as male or female or identify as heterosexual, or, for cross-national analyses,
257 iii) if their IP address did not match their reported country of residence. After applying
258 exclusion criteria (see Data analysis), we analyzed data from the full eligible sample ($N =$
259 1428 participants, 336 men, 1092 women. $M_{\text{age}} = 32.90$ years, $SD = 11.59$ years), and for
260 analyses comparing nations (seven countries from three continents), included countries with
261 data from at least 50 respondents ($N = 970$ participants, 251 men, 719 women. $M_{\text{age}} = 34.16$
262 years, $SD = 12.28$ years), who reside in the same country as their birth (following Watkins et
263 al., 2019), which exceeds 80% power to detect moderate effects (Lakens & Evers, 2014).

264 **Measures**

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265 *Demographic information.* Participants first provided demographic information and proxies
266 for ‘mate quality’ (sex, age, sexual orientation, country of residence, country of birth,
267 relationship status, relationship length, ethnicity, self-rated attractiveness) before completing
268 three questionnaires in a randomized order, with other questionnaires unrelated to the current
269 study (see Watkins et al., 2019). Attractiveness of self was measured on a one (much less
270 than average) to seven (much more than average) scale.

271 *Love confession questions.* For the current study, participants completed a six-item
272 questionnaire adapted from Ackerman et al. (2011) and the thirty-six item Experiences in
273 Close Relationships Questionnaire (ECR, Brennan, Clark, & Shaver, 1998). Participants were
274 asked to complete the love confession questionnaire if they were describing a current
275 relationship where both partners had said, “I love you” at least once in the relationship or if
276 they were describing their most recent past relationship where both partners confessed love at
277 least once. Following Ackerman et al. (2011), participants were asked, in the last/current
278 relationship in which someone confessed their love, who admitted love first (Options: Me,
279 My Partner, N/A). The answer to this question was used to create our binary “*male*
280 *confession bias*” variable (man confessed first = 1, woman confessed first = 0). Ackerman
281 and colleagues (2011) found converging evidence for a male confession bias when this item
282 was administered in reference to a past relationship, and when it was administered to current
283 couples. They were also asked, separately and in days, how long into the relationship i) they
284 began thinking about saying they were in love, ii) they confessed to their partner that they
285 loved them, iii) their partner confessed to them that they loved them. As delays in
286 reciprocation are of interest in understanding romantic relationship functioning over time,
287 these two last variables were combined into our continuous “*male confession bias*” variable
288 representing the difference in days between the woman’s and the man’s confession in the
289 relationship. High scores above zero on this variable indicate that the man in the relationship

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290 confessed love earlier than was reciprocated by his partner. Scores below zero indicate that
291 the woman in the relationship confessed love earlier than her partner did. Participants were
292 also asked to record iv) in general in romantic relationships, how happy they feel when
293 hearing their romantic partner say “I love you” on a 0 (Not at all) to 100 (Extremely happy)
294 scale. Finally, participants were asked, “in general, when does it become acceptable to admit
295 love in a new relationship”, with the options, “First day”, “two to three days”, “One week”,
296 “Two to three weeks”, “One month”, “Two to three months”, “Six months”, “One year”, and
297 “Two or more years”.

298 *Attachment styles.* For the ECR (Experiences in Close Relationships) scale, participants were
299 informed that the statements concern how they feel in romantic relationships, and we were
300 interested in how they generally experience relationships, rather than what is happening in a
301 current relationship. Participants were asked to respond to each statement by indicating how
302 much they agree or disagree with it on a one (Disagree strongly) to four (neutral/mixed) to
303 seven (agree strongly) scale. Complete responses to items ($N = 1235$) were averaged and used
304 to calculate two dimensions with high scores indicating anxious attachment ($M = 3.58$, $SD =$
305 1.13 , range = 1.00 – 6.56) and avoidant attachment ($M = 2.44$, $SD = 0.91$, range = 1.00 –
306 6.39) respectively. Reliability measures for both subscales were excellent (both Cronbach’s α
307 = 0.90). After completing all questionnaires, participants were debriefed and could exit the
308 survey.

309 *Translations and country-level data.* Native speakers based at a university translated foreign
310 language versions of the study (French, Spanish, Brazilian Portuguese, Italian, German, and
311 Polish), with published and translated versions of the ECR consulted where necessary
312 (French and Italian versions of the ECR-R; Busonera, Martini, Zavattini, & Santona, 2014;
313 Favez, Tissot, Ghisletta, Golay, & Notari, 2016). Statistics for national sex ratio (2017
314 estimates, adult and operational sex ratios for ages 15-54) were obtained in March 2018 from

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315 the CIA world fact book [https://www.cia.gov/library/publications/the-world-](https://www.cia.gov/library/publications/the-world-factbook/fields/print_2018.html)
 316 [factbook/fields/print_2018.html](https://www.cia.gov/library/publications/the-world-factbook/fields/print_2018.html). A ratio above one indicates a male biased sex ratio and a
 317 ratio below one indicates a female biased sex ratio (all eligible countries shown in Table 1,
 318 except Australia, had a female-biased sex ratio based on 2017 estimates).

319 **Data Analysis**

320 First, Chi square tests on the binary *male confession bias* variable examined whether
 321 men were more likely to admit love first than women were, with data analyzed across the
 322 sample and for each sampled nation separately. We also tested for sex differences in i) days
 323 into the relationship before thinking and ii) confessing love, and iii) happiness at hearing “I
 324 love you” using t-tests.

325 Then, generalized linear mixed effects models (GLMMs) were run to test for
 326 relationships between national sex ratio and *male confession bias* (both binary and continuous
 327 variables), nested within the higher-level variable of country (random intercept).

328 Finally, a linear mixed effects model (LMM) on the continuous *male confession bias*
 329 variable was run with the between subjects’ factor *participant sex*, the covariates *anxious*
 330 *attachment score* and *avoidant attachment score* and each covariate entered separately as a
 331 two-way interaction term with the between subjects’ factor, and with a random intercept for
 332 each country³. Models were re-run with different outcome variables: *First thought about*
 333 *confessing love* (days into the relationship); *First love confession* (days into the relationship,
 334 i.e., in absolute terms instead of relative to partner); and *Happiness at hearing “I love you”*.
 335 Two additional non-pre-registered models were run on *Partner’s love confession* (days into
 336 the relationship in which their partner confessed love) and the binary *male confession bias*
 337 variable.

³ The pre-registration mentions a custom ANCOVA without the random intercept for the country. The ANCOVAs were replaced by LMMs with random intercepts after a round of peer-review. Both type of models gave an identical pattern of results.

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338 Data on number of days before love confessions were analyzed if the respondent gave
339 a definitive numerical answer (with an average taken if the participant estimated a range
340 within 10 days) that was logical (i.e., thinking about confessing love *before* saying it; days
341 before confessing love was less than the participant's age), complete (i.e., provided data on
342 when love was confessed/reciprocated and who confessed first) and consistent with their
343 other responses to these questions (i.e., on who confessed first). Details of further robustness
344 checks are provided in the results. This included repeated tests after the exclusion of outliers,
345 to confirm whether outliers exert any undue influence on the conclusions derived from our
346 models, given that extreme values could still represent genuine responses. Of the total sample
347 recruited, 4% were dropped for not being eligible for broad/initial analyses of the sample as
348 described in the participants section, with a further 12% dropped for not being heterosexual.
349 Forty-nine percent of the recruited sample did not meet the criteria for cross-cultural analyses
350 detailed in the participant's section. Four percent were dropped for not completing the love
351 confession questions correctly, and six percent were dropped for analyses involving
352 attachment as they did not complete all items on the questionnaire. Four percent were
353 dropped for analyses involving both attachment and cultural differences due to missing data
354 on these items.

355

356 **RESULTS**357 **The male confession bias across cultures (Hypothesis # 1)**

358 Participants reported that men confessed love first in the relationship at levels greater
 359 than chance ($\chi^2(1) = 170.89; p < .001$). Interestingly, a greater proportion of women than men
 360 reported that men confessed love first in the relationship ($\chi^2(1) = 19.40; p < .001$), a reporting
 361 or memory bias observed previously (Ackerman et al., 2011). However, the male confession
 362 bias effect was still significant when Chi square tests were split by respondent sex (both $\chi^2(1)$
 363 > 7.44 , both $p < .007$). Men confessed love first in six of the seven countries with sufficient
 364 data (see Table 1), representing a mean weighted effect size (r) across nations of 0.59 (95%
 365 CI [0.55, 0.63], as calculated in Watkins et al. (2019). Of note, while there was no significant
 366 sex difference in France, a one-tailed prediction would be valid for Australia given the
 367 directional pre-registered hypothesis, and as the confidence intervals for the effect size
 368 suggest a moderate effect.

369 No sex differences were observed in days in which respondents first thought about
 370 confessing love ($M_{\text{men}} = 69.87$ days, 95% CI [60.04, 79.69], $M_{\text{women}} = 76.99$ days, 95% CI
 371 [71.19, 82.79], absolute $t(1411) = 1.19; p = .23$), days into the relationship in which love was
 372 confessed ($M_{\text{men}} = 107.76$ days, 95% CI [90.13, 125.39], $M_{\text{women}} = 122.61$ days, 95% CI
 373 [104.08, 141.15], absolute $t(1426) = 0.84; p = .40$) or happiness at hearing ‘I love you’ (M_{men}
 374 $= 87.01$, 95% CI [85.29, 88.74], $M_{\text{women}} = 88.73$, 95% CI [87.81, 89.66], absolute $t(1421) =$
 375 $1.76; p = .08$).

376 **The male confession bias between cultures (Hypotheses # 2a and #2b)**

377 A generalized linear mixed-effects model (GLMM) using the logit link function on
 378 the binary variable *male confession bias* (Full model: *Male confession bias* ~ *National Sex*
 379 *Ratio* [nested within country] + *Participant Sex* + *Participant age* + *Relationship status* +
 380 *Self-rated attractiveness*) revealed a negative effect of *National Sex Ratio*, before and after

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381 outliers were excluded and with and without control variables (*Participant sex* was the only
 382 significant control variable in this model, $Est(b) = 0.46$, $SE = 0.15$, $t = 2.95$; $p < .01$). Men
 383 were more likely to confess love first if they lived in a nation with a relatively more female-
 384 biased sex ratio ($Est(b) = -10.51$, $SE = 4.85$, $t = -2.16$, $p = .04$ for the full model). Of note, we
 385 chose participants' sex, age and relationship status as the control variables to include in our
 386 models as a robustness check because these variables may have an effect on the outcome
 387 variable and their distributions might differ between countries in light of our convenience
 388 sampling strategy.

389 Running this same model (but with the identity link function) on our continuous *male*
 390 *confession bias* variable revealed effects of *Participant sex* ($Est(b) = 23.17$, $SE = 5.20$, $t =$
 391 4.46 ; $p < .001$) and *Relationship status* ($Est(b) = 13.98$, $SE = 5.90$, $t = 2.37$; $p = .02$) only
 392 after controlling for outliers ($\pm 3SD$). No effects of the *National Sex Ratio* were observed in
 393 the simple model (*National Sex Ratio* only), after controlling for outliers, or when including
 394 the above demographic characteristics as a robustness check (all other absolute $t < 1.51$, all
 395 other $p > .14$). We should note here that the *continuous male confession bias* used in these
 396 models is less informative than the binary variable used in the previous set of models. We
 397 have more confidence in the results of these first models, as most people responded to a love
 398 confession on the same day as their partner (see discussion).

399 **Individual differences in the male confession bias (Hypothesis #3)**

400 To test Hypothesis # 3, which involves combinations of several continuous and
 401 categorical variables plus their interactions, separate LMMs were run (*Outcome variable* ~
 402 *Participant sex* + *Anxious attachment style* + *Avoidant attachment style* + [*Anxious*
 403 *attachment style* * *Participant sex*] + [*Avoidant attachment style* * *Participant sex*] + [1 |
 404 *Country*]) on the following outcome variables: continuous *male confession bias*; *First*
 405 *thought about confessing love*; *First love confession*; *Happiness at hearing 'I love you'*;

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406 *Partner's love confession*; and a GLMM using the logit link function was run on the binary
407 *male confession bias* variable. These analyses revealed no significant main effects or
408 interactions (all $p > .07$), except for a negative relationship between avoidant attachment style
409 and *Happiness at hearing 'I love you'* (Est(b) = -5.83, SE = 0.96, $t = -6.06$; $p < .01$) and a
410 positive relationship between anxious attachment style and *Happiness at hearing 'I love you'*
411 (Est(b) = 2.13, SE = 0.78, $t = 2.72$; $p < .01$), which remained significant after excluding
412 outliers (see supplementary materials and Figure 1 for effect sizes). Excluding outliers
413 resulted in significant interactions between *participant sex* and both *avoidant attachment*
414 *style* and, separately, *anxious attachment style* for the model on continuous *male confession*
415 *bias* (see supplementary materials). These interactions were driven by women's, but not
416 men's, attachment style, such that *more* avoidant and *less* anxious women took longer to
417 confess love relative to their partner. As this was not observed in the full dataset, we do not
418 interpret these interactions further. Similar non-robust results were observed for an additional
419 model using the binary, instead of the continuous, *male confession bias* variable (see
420 supplementary materials). Of general note, we observed no sex differences across the sample
421 in avoidant ($M_{\text{men}} = 2.45$, $M_{\text{women}} = 2.44$, 95% CI [-0.11, 0.13], absolute $t(1233) = 0.17$; $p =$
422 $.87$) or anxious attachment styles ($M_{\text{men}} = 3.50$, $M_{\text{women}} = 3.61$, 95% CI [-0.26, 0.04], absolute
423 $t(1233) = 1.50$; $p = .13$), while anxious and avoidant styles were correlated in both men
424 ($r(282) = .17$; $p = .004$) and women ($r(949) = .17$; $p < .001$).

425

426 **DISCUSSION**

427 As predicted (Hypothesis # 1) and consistent with previous results (Ackerman et al.,
428 2011), men, across different nations, were more likely than women to confess love first in a
429 romantic relationship. When split by countries with sufficient data (seven countries, three
430 continents), this ‘male confession bias’ was large in effect size and observed in six of the
431 seven countries, with non-significant results from France still in the predicted direction.
432 However, no sex differences were observed in the duration before thinking about confessing
433 love or level of happiness at hearing a love confession, revealing a sex difference in speech
434 acts but not the accompanying emotional response to a love confession. In contrast to
435 predictions (Hypothesis # 3), no robust relationships were observed where respondent
436 attachment style predicted the difference between partners in their timing of a love
437 confession. Our data instead suggest that insecure attachment styles predict emotional
438 responses to a love confession across men and women. Here, avoidant people were less
439 happy to hear a love confession than less avoidant people (Figure 1a) while anxiously
440 attached people were happier to hear a love confession than less anxious people, with this
441 latter effect very small (Figure 1b). We also observed preliminary evidence that confessing
442 love first was related to the national sex ratio, such that men were more likely to confess love
443 first when they lived in countries where they had more choice (i.e., more women than men in
444 the population, Hypothesis #2b). In summary, we found that the male confession bias is
445 observed in a cross-national sample and environmental factors (sex ratio) may moderate the
446 likelihood that men confess love first, while attachment styles moderate emotional responses
447 to love confessions.

448 Our findings support theory and corroborate evidence on sex differences in mating-
449 related cognition and behaviors (e.g., Haselton & Buss, 2000; Janicke et al., 2016; Johnson et
450 al., 2013; Todd et al., 2007; see also Walter et al., 2020) within a relatively diverse sample,

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451 replicating some patterns observed in campus and online research of American couples and
452 individuals retrospectively recalling a past relationship (Ackerman et al., 2011). Our findings
453 develop the literature on attachment styles and romantic relationships by suggesting that they
454 moderate emotional responses to speech acts (hearing someone tell them they love them),
455 which may be important for the feeling of love and relationship outcomes, particularly if it is
456 the case that individuals with insecure attachment styles seek complimentary insecure
457 partners (i.e., avoidant individuals couple with anxious individuals and vice versa; Holmes &
458 Johnson, 2009). Of note, our dataset did not observe sex differences in attachment styles,
459 possibly because these sex differences are smaller in online studies (reviewed in Del Giudice,
460 2011). Our work also supports sex ratio theory (e.g., Del Giudice, 2012) by providing
461 preliminary evidence that national sex ratios predict the likelihood of men confessing love
462 first in a romantic relationship. If this is replicated in independent samples, it may suggest
463 that the escalation of sexual intimacy (via love confession) is more likely in environments
464 where men have greater mating opportunities and female promiscuity is relatively more
465 common (see Del Giudice, 2011 for discussion). Of course, it may also suggest ‘honest
466 signaling’ of male commitment in an environment where potential mates are relatively
467 abundant and they have more ‘bargaining power’ in mate choice, all else equal (see, e.g., Del
468 Giudice, 2012). Further research should examine the different contexts that motivate our use
469 of romantic speech acts and our responses to them, both experimentally and using diary-
470 based methods, to establish when these behaviors are honest or manipulative.

471 Consistent with Ackerman et al. (2011), we observed a reporting bias, where a greater
472 proportion of women than men reported that men confessed love first in a relationship. This
473 may suggest that social stereotypes associating women with romantic intimacy, or motivated
474 reasoning on these issues to maintain a particular self-image, might shape people’s memory
475 of this episode. For example, if folk beliefs tend to associate women with romantic love,

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476 romantic behavior that counters these intuitions may be better retained in women's memories
477 (as the recipient of a love confession) than men's memories. However, our models take this
478 bias into account by controlling for the sex of the respondent, and these findings converge
479 with prior evidence from an ethnically homogenous sample of both current couples and
480 individuals providing retrospective accounts, who report that men confess love before women
481 (Ackerman et al., 2011), which also suggest that our pattern of results are unlikely to be
482 artefacts of a recency bias in responses.

483 Contrary to predictions, we observed no robust relationships where respondent
484 attachment style predicted the difference between partners in their timing of a love
485 confession. This may be because there were no sex differences observed in attachment style
486 within our sample, which would have underpinned our proposed interaction between
487 attachment style and the male confession bias, for example, by moderating the time perceived
488 as necessary to judge a relationship as close (Hudson & Fraley, 2017) and their subsequent
489 confession and/or reciprocation. Alternately, because any effects we did observe involving
490 attachment style and biological sex were not robust (i.e., were not observed pre- and post-
491 outlier exclusion), traits or motives other than attachment style may be important in
492 relationships where the timing and reciprocation of a love confession is atypical, or the
493 relationship is maintained based on certain types of love only (Sternberg, 1986). It is also
494 possible, however, that some of our null findings on this issue were false negatives, given that
495 a power analysis requested by reviewers suggested that we had sufficient power to detect
496 interactions of moderate, but not small, effect size, due to the skew of males to females in our
497 final sample. We suggest some caution in interpreting the data on the relative difference in
498 days between both partners' confessions (the continuous *male confession bias* variable),
499 given that many of our participants reported that both dyad members confessed on the same
500 day, and because participants may have a fallible recollection of the exact timing of their own

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501 and their partner's love confessions. This is why we also used a binary variable (who
502 confessed love first in the relationship) in our models, as a more reliable measure of the
503 relative timing of a love confession. Further longitudinal work in representative samples of
504 couples could help address these issues, for example, by incorporating diary-based methods
505 or examining the frequency of love confessions and other forms of intimacy over time. This
506 would also enable researchers to directly examine the interaction between different
507 attachment styles in relationships and its possible effects on love confessions, as a limitation
508 of our dataset is that we only have information about the respondent's attachment style (and
509 not their partner).

510 In light of our convenience recruitment and sampling strategy, some continents were
511 not captured in the current project (Africa and Asia), and some countries within our sample
512 were not independent, such as Australia, which is culturally and historically connected to the
513 UK. Thus, before claiming that the male confession bias is universal, further research
514 conducted in additional countries (ideally including remote societies) would also be
515 important to examine the extent to which the male confession bias generalizes to these
516 countries as well. A valuable follow-up study would include regions with a wider range of
517 sex-ratios (6 of the 7 countries in our dataset had a female-biased sex-ratio), to investigate if
518 the cross-cultural variation observed here is robust. These findings may also motivate further
519 work on the hormonal mechanisms involved in emotions and affection within close
520 relationships, if attachment styles shape oxytocin responses to behaviors that are important
521 for successful pair bonds (reviewed in Bartz et al., 2011; see also Schneiderman, Kanat-
522 Maymon, Ebstein, & Feldman, 2014 for relationships between oxytocin and couple
523 communication). Finally, due to local data protection legislation and some ethical
524 considerations, we did not collect data on participant location (beyond confirming that their
525 IP address matched their self-reported country), ethnicity, nor status (socioeconomic,

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526 disability, and student status). Although we would not anticipate our *a priori* hypotheses to be
527 necessarily refuted within sufficiently powered samples of different demographic groups,
528 except perhaps confession timing in groups of people attracted to the same- or both sexes, it
529 would of course be interesting to examine the same phenomena in these contexts.

530 That biological sex motivates speech acts that are important in the progression of a
531 romantic relationship, while both men and women *emotionally respond* similarly to a love
532 confession in light of their attachment styles, highlights the importance of examining both
533 cognition and affect when studying how people navigate relationships over time. Pending
534 further research into this area, these findings may, for example, have utility for relationship
535 counselling, if alignment between what people say and how they feel is important for
536 relationship outcomes (e.g., a ‘Rogerian’ view on the conditions required for personal
537 growth; Rogers, 1961). Although further work on the motives for confessing love is
538 necessary, our findings demonstrate a theory-driven sex difference in speech acts that will
539 influence the recipient’s emotional response and accompanying behaviors (e.g., to
540 reciprocate, lie, delay etc.) within relationships, regardless of the explicit motive for the
541 underlying love confession.

542 To conclude, we replicate the ‘male confession bias’ in a large cross-national sample.
543 Our findings provide the first cross-national comparison of romantic speech acts and our
544 verbal and/or emotional responses to them, while considering the factors that do and do not
545 moderate these behaviors (biological sex, attachment style, social environment). This simple
546 three-word phrase can inspire much more effort within relationship science.

547

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729 **Table Captions**

730 **Table 1.** Cross-cultural analyses showing the proportion of each national sample in which
731 men confessed love first in their current/most recent romantic relationship.

732

733 **Figure Captions**

734 **Figure 1.** People with avoidant attachment styles are less happy to hear their partner confess
735 love than less avoidant people (Panel a. Raw correlation $r = -0.36$, 95%CI [-0.41, -0.31]).

736 People with anxious attachment styles are happier to hear their partner confess love than less
737 anxious people (Panel b. Raw correlation $r = 0.05$, 95%CI [-0.005, 0.11]). Following Lee &

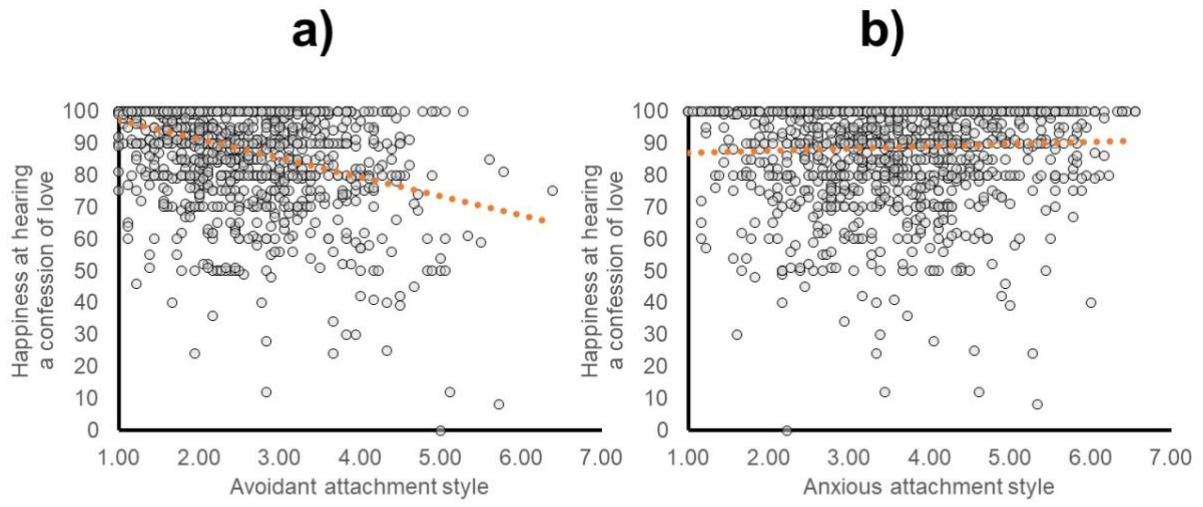
738 Preacher (2013), these two raw correlations differed significantly from one another (absolute
739 Z value = 11.67; $p < .0001$).

740 **Tables**741 **Table 1.**

Country	<i>N</i>	<i>M</i>	<i>t</i>	<i>p</i>	Effect size	95% CI
					(<i>d</i>)	(of ES)
Australia	63	0.62	1.93	=.06	.53	[.42, .65]
Brazil	70	0.79	5.78	<.001	.69	[.60, .79]
Chile	69	0.81	6.57	<.001	.72	[.62, .82]
Colombia	130	0.68	4.51	<.001	.59	[.51, .66]
France	59	0.59	1.44	=.15	.51	[.37, .65]
Poland	54	0.76	4.41	<.001	.66	[.54, .78]
UK	525	0.65	7.07	<.001	.56	[.52, .60]

742

743 **Figures**



744

745 **Figure 1.**

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