

Does Viewing Cats and Dogs Influence People's Mood, Optimism and the Desire to Have Children?

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1 **Does Viewing Cats and Dogs Influence People’s Mood, Optimism and the Desire to Have Children?**

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3
4 **Abstract**

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8 5 Photos of cats and dogs are among the most popular kinds of material on the internet. Our large-scale study
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10 6 (n = 8,865) tested the influence of viewing cat and dog images on the desire to have children, mood, and
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12 7 optimism. Main effects of priming on all these three variables were insignificant both in the general
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14 8 population and subpopulations of cat and dog lovers. Nevertheless, a priming–gender interaction might have
15
16 9 a slight influence on optimism in the general population. Additionally, liking of companion animals was
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18 10 associated with a lower number of children, whereas the keeping of animals was associated with a higher
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20 11 number of children. This may indicate that animals do not decrease fertility of their keepers as previously
21
22 12 suggested but having children decreases liking these animals. Our results showed that the effect of watching
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24 13 cats and dogs might be much weaker than one would expect based on previous studies.

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26 14 Keywords: cats, dogs, mood, optimism, desire to have children
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15 **Introduction**

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17 Many people enjoy watching photos and videos of cats and dogs on the internet. In December 2019, tag
18 “#catsofinstagram” over 120.5 million times, and tag “#dogsofinstagram” about 170.7 million times. Some
19 cat and dog “influencers” have several million followers on Instagram, Facebook, and YouTube (Bruner,
20 2019; Leskin, 2019). Moreover, it seems that in Great Britain, images of cats are even more popular than
21 selfies (Williams, 2014). This raises questions why these materials are so popular and how they influence
22 people.

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24 In general, people tend to believe that companion animals have a positive influence on them. Canistherapy
25 and feline therapy seem to have a positive effect on emotions and they have the potential to aid the treatment
26 of mental disorders (Lundqvist, Carlsson, Sjö Dahl, Theodorsson, & Lars-Åke Levin 2017; Nimer, &
27 Lundahl, 2007; Tomaszewska, Bomert, & Wilkiewicz-Wawro, 2017). The presence of a cute dog (Aydin et
28 al., 2011) and even just writing about a favorite companion animal (McConnell, Brown, Shoda, Stayton, &
29 Martin et al., 2011), makes people feel better after experimentally induced feelings of social rejection. Petting
30 a dog decreases anxiety more than petting a stuffed animal does, especially in anxious people (Wheeler, &
31 Faulkner, 2015). The results of studies on companion animals’ influence on their keepers are, however,
32 mixed (Herzog, 2011).

33

34 Visual materials of cats and dogs seem to affect people in various ways. People tend to judge other persons
35 or their offices more positively when a dog (Budge, Spicer, Jones, & George 1996; Geries-Johnson, &
36 Kennedy 1995; Lockwood, 1983; Perrine, & Wells, 2016; Rossbach, & Wilson 1992; Wells, & Perrine 2001)
37 or cat is present (Budge et al. 1996; Perrine, & Wells, 2006). Viewing of photos of cats and dogs, especially
38 if people are asked to come up with names for them, provides relief from social rejection (Brown Hengy, &
39 McConnell, 2016). People who regularly watch cat videos claim that their emotions after last watching of
40 such material are more positive than before (Myrick, 2015). Interestingly, exposure to images of kittens and
41 puppies makes people more careful when performing fine-motor tasks compared to exposure to images of
42 adult cats and dogs (Nittono, Fukushima, Yano, & Moriya, 2012; Sherman, Haidt, & Coan 2009). All in all,
43 it seems that visual materials of cats and dogs have a clearly positive effect on people.

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1
2 45 Nevertheless, studies such as those mentioned above are mostly based on relatively small sample sizes and
3
4 46 sometimes can be influenced by respondents' opinions on companion animals. Moreover, negative results
5
6 47 are much less likely to be published (Herzog, 2011). One thus cannot exclude the possibility of publication
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8 48 bias skewing the image of research in this field. This is why we thought it necessary to replicate previous
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10 49 positive results in an experimental study with a large sample size.

12 50

14 51 In our study, we tried to avoid several potential methodological pitfalls. First of all, we carefully avoided
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16 52 any hints to the effect that we are interested in the influence of cats and dogs on people. We did not even
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18 53 mention these animals during the recruitment of our respondents. This way, we hoped to prevent invalidation
19
20 54 of our results by interference with respondents' opinions about cats and dogs and their usefulness to people.
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22 55 Additionally, the steps we took should have prevented an inflated ratio of cat and dog lovers in our sample
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24 56 who might respond to our images differently than the general population. And finally, we preregistered our
25
26 57 study to avoid risk of any data dredging, cherry picking, or p-value fishing artifacts.

29 58

31 59 In addition to mood and optimism, we decided to also test the effect of priming by cats and dogs on the
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33 60 desire to have children. To the best of our knowledge, this relationship has not been studied yet. It has been
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35 61 shown, however, that people without children in their household are more attached to their companion
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37 62 animals (Paul, 2014). Moreover, liking of cats and dogs is related to a lower number of children (Flegr, &
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39 63 Preiss, 2019) and it has been hypothesized that companion animals might be social parasites who compete
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41 64 with children for the same resources (Archer, 1997). We have therefore hypothesized that viewing of images
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43 65 of cats and dogs might decrease the desire to have children.

46 66

67 **Materials and methods**

68

69 *Subjects*

70

71 The online questionnaire was distributed mainly by members of the xxxxx anonymized for the purpose
72 of review process xxxxxx community, a group of app. 20,000 xxxxx anonymized for the purpose
73 of review process xxxxxx nationals willing to take part in evolutionary psychology experiments. The
74 survey was presented as a “Calculator of partner preferences”, which were computed based on each
75 participant’s rating of photos of cats and dogs and shown on the last page of the survey.

76

77 Participants expressed their consent to providing anonymous responses for scientific purposes and could ask
78 to have their data excluded from the analysis after completing the survey. Data collection started on
79 December 24, 2018 and was completed on February 3, 2019, i.e., one day after our stopping rule was
80 fulfilled. The final sample consisted of 11,778 responses.

81

82 The project was preregistered using the OSF system (xxxxx anonymized for the purpose of review
83 process xxxxxx). The project was approved by the IRB of xxxxx anonymized for the purpose of
84 review process xxxxxx.

85

86 *The questionnaire*

87

88 The data were collected using an online survey designed in the Qualtrics environment. The questionnaire
89 consisted of four parts: i) the introductory part, ii) rating of cats or dogs, iii) primed questions, and iv) the
90 final part. Participants were randomly divided in two groups of the same size. One of these answered the
91 priming questions before rating cats or dogs, while the other half rated cats and dogs prior to responding to
92 the priming questions. Potential differences between these two groups in gender, age, dog/cat keeping, the
93 number of own children, and number of children in a household were checked using t-test or contingency
94 table with respect to variable type. Additionally, primed participants were randomly selected to rate either
95 cats or dogs. These two randomizations were independent of each other and both were performed using
96 Qualtrics built-in randomizer. The questionnaire also contained questions unrelated to this study.

97

98 In the introductory part of the questionnaire, we asked participants about their age (in years), gender (“You
99 were officially born as: male or female”), sexual attraction to people of the opposite and of the same sex
100 (two seven-point Likert scales; 0 = definitely not, 6 = definitely yes), liking of cats and dogs “I like cats/dogs
101 very much” (scale 0–100; 0 = I completely disagree, 100 = I completely agree), and four other questions
102 regarding the number of cats and dogs kept currently and in the past (Flegr, & Preiss 2019).

103 In the rating part of the survey, we asked participants to rate forty photographs of cat or dog ‘faces’
104 using eight-point Likert scales in terms of likeability (1 = very unlikeable, 8 = very likeable; in xxxxx
105 anonymized for the purpose of review process xxxxxx we used the term xxxxxx anonymized for
106 the purpose of review process xxxxxx) and beauty (1 = very ugly, 5 = very beautiful; in xxxxx
107 anonymized for the purpose of review process xxxxxx). Each image was presented on a separate
108 page, with both scales showing below it.

109

110 Photographs showing frontal views of cats and dogs heads were provided by xxxxx anonymized for the
111 purpose of review process xxxxxx several years ago for similar studies. We selected the best-quality
112 photos of diverse phenotypes of both cats and dogs. We used rating instead of just viewing of photographs
113 because we wanted to prevent respondents from suspecting they are being primed. Moreover, we needed

114 these ratings to provide respondents with an interesting feedback about themselves at the end of the survey,
115 which we promised to motivate respondents to complete our survey in their free time.

116
117 In the survey, we used six primed questions. The first two concerned the desired number of sons and
118 daughters (“How many sons (daughters) would you ideally like to have (in total)?”), with response taking
119 the form of numbers from zero to five, where five meant five or more. These two questions about sons and
120 daughters were placed within a group of four other questions about children to prevent respondents from
121 realizing the actual goal of this study (which could influence their responses). The variable desired number
122 of children was computed as a sum of these two variables.

123
124 The remaining four priming questions were presented together at one page of the survey. These questions
125 were answered on six-point Likert scales with labels on both sides: i) “I am in a better physical condition
126 than other people” (0 = definitely not, 5 = definitely yes), ii) “I am in a better mental condition than other
127 people” (0 = definitely not, 5 = definitely yes), iii) “How would you rate the quality of your life?” (0 = very
128 bad, 5 = very good), iv) “How do you feel right now?” (0 = very miserable, 5 = very well). Response to the
129 last question was interpreted as indicating actual (conscious) mood. Variable “optimism index” was
130 computed for each respondent as an average z-score of responses to the first three questions mentioned
131 above. Justification of the method used to compute this index is presented in the first part of the discussion.

132

133 *Data filtering and statistical analyses*

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135 All data analyses were done using R. We filtered data in the same way as xxxxx anonymized for the
136 purpose of review process xxxxxx. Additionally, we filtered data from responses with average rating
137 time lower than 400ms, who likely did not watch the photographs carefully.

138

139 In the confirmatory part of this study, we analyzed the influence of viewing cats or dogs on i) optimism, ii)
140 actual mood, and iii) the desired number of children. The first relationship was tested using general linear
141 model (GLM; R package stats 3.5.2; function glm with identity link function), the latter two were explored

142 using ordinal regression models, also known as cumulative link models (CLM; R package ordinal 2018.8.25;
143 Christensen, 2018; function clm with logit link function).

144
145 Priming was coded as a binary variable, i.e., we distinguished only whether respondents were primed or not.
146 Respondents' age and gender and their interactions with priming were used as covariates. Where necessary,
147 we relaxed proportional odds assumption was relaxed (using the scale option).

148
149 In the exploratory part, we tested the same relationships as in the confirmatory part but used subsamples of
150 cat and dog lovers (i.e., liking of cats/dogs > 50 on a 100-point scale). Cat lovers primed by dogs and dog
151 lovers primed by cats were not included. The relationship between the real number of children and liking
152 companion animals, as well as between the real number of children and companion animals keeping was
153 tested using partial Kendall correlation tests (tau; R package ppcor 1.1; Kim, 2015; function cor.test) with
154 age as a covariate.

155
156 *Differences between the preregistered and the implemented protocol*

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158 Our target sample size after the filtering was 5,000 respondents. Based on our previous experience, we
159 supposed the number of responses before filtering should be approximately 10,000, as stated in the
160 preregistration. We terminated data collection one day after our sample size reached the target size. By that
161 time, however, our sample size was approximately 11,750 because of a TV interview with the corresponding
162 author (where, however, neither cats or dogs nor priming was mentioned). Additionally, we had to exclude
163 much fewer responses than the expected half: probably because of shortness and interesting topic of the
164 questionnaire. The final sample size was therefore significantly higher than expected (8,865 instead of
165 5,000).

166
167 The inclusion of interaction of gender and age with priming was not explicitly mentioned in the
168 preregistration, nor did we explicitly state that we would filter out the responses of people who went through
169 the rating conspicuously fast. Aside from this, we extended the exploratory analysis to find an explanation
170 for our unexpected results.

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Results

Descriptive statistics

The final sample consisted of 3,963 men (mean age = 36.96, SD = 11.13) and 4,902 women (mean age = 34.44, SD = 11.14). Distributions of variables used in the models are shown in figure 1. Primed and non-primed respondents did not significantly differ in gender, age, or variables regarding present dog/cat keeping, number of own children and number of children in the household ($p > 0.083$). Internal reliability of three variables used in the computation of optimism index expressed as Cronbach alpha is 0.78, which is commonly interpreted as acceptable.

Figure 1 here

The confirmatory part

In this part, we tested the following preregistered hypotheses: i) people are on average in a better mood after rating photos of cats or dogs than before, ii) people are on average more optimistic (i.e., they give higher rating to their quality of life and mental and physical health) after rating photos of cats or dogs than before rating them, iii) people report wanting to have fewer children after rating photos of cats or dogs than before rating them. All three models – i.e., GLM model with optimism index as a dependent variable and priming, gender, and age as independent variables, CLM with either mood or the desired number of children as a dependent variable and the same independent variables – explained data significantly better than corresponding null models with p-values lower than 0.0001. The full results of these analyses are shown in table S1.

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199 Actual mood

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201 Actual mood was significantly predicted neither by priming itself (estimate = 0.063, $z = 0.478$, $p = 0.6325$)
202 nor by its interaction with age or gender. The only significant predictor in this model was age, where older
203 people tended to be in a better mood (estimate = 0.021, $z = 8.380$, $p \ll 0.0001$).

204

205 Optimism

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207 The effect of interaction between priming and gender on optimism was significant (estimate = 0.105
208 , $t = 3.135$, $p = 0.002$), difference in WAIC (R package blmeco 1.4; Korner-Nievergelt et al., 2015) between
209 this model and corresponding model without this interaction was 5.972. Primed women reported lower
210 optimism than the controls (-0.080 vs. -0.041), while in men the direction of the effect was the opposite
211 (0.028 vs. 0.075). Nevertheless, the effect sizes expressed as Cohen's d (R package effsize 0.7.6; Torchiano,
212 2020) were negligible (primed vs. non-primed men: 0.0627; non-primed vs. primed women: -0.050) and
213 their 95 confidence intervals included zero (non-primed vs. primed men: -0.002 to 0.128
214 ; non-primed vs. primed women: -0.108 to 0.008). Generally, the optimism index was almost the same in
215 the primed people and the controls (mean = -0.01, estimate = 0.059, $t = 1.057$, $p = 0.291$). The effect of
216 gender itself was not significant (estimate = 0.031, $t = 1.327$, $p = 0.184$) and optimism index increased with
217 respondents' age (estimate = 0.013, $t = 12.233$, $p \ll 0.0001$).

218

219 Desired number of children

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221 The desired number of children did not significantly depend on either priming itself (estimate = 0.031, $z =$
222 0.225, $p = 0.822$) or its interaction with one of the covariates. It did, however, significantly depend on age
223 and gender. Older people wanted to have more children than younger people did (estimate = 0.019, $z = 7.359$,
224 $p \ll 0.0001$) and men wanted to have more children than women did (estimate = 0.242, $z = 4.126$, $p <$
225 0.0001).

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1
2 227 *The exploratory part*

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7 229 In the exploratory part, we tested relationships between the same variables as in the confirmatory part. In the
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9 230 first model, however, we analyzed data from respondents who liked cats (1,547 men and 2,478 women) or
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11 231 dogs (1,889 men and women 2,757) separately, that is, we tested only subsamples of responders who rated
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13 232 their liking of cats or dogs at least by 50 points on the 0–100 scale. In the second model, priming was not
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15 233 encoded as a binary variable as in the previous models. Instead, it had three values: “cats”, “dogs”, or “none”.
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17 234 In another model, we encoded the desire to have children as a binary variable, that is, we compared
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19 235 respondents who do not want any children with respondents who want at least one child. Additionally, we
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21 236 tested the relationship between liking or keeping cats and dogs and both the real and the desired number of
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24 237 children.

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28 239 Regarding the data from cat and dog lovers, neither the effect of priming nor its interaction with age or
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30 240 gender were significant in any of these models. Even the effect of interaction of priming and gender on the
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32 241 optimism index, which was significant in a model based on the whole dataset, became insignificant in both
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34 242 models based on subpopulations (dog lovers: 0.060, $t = 1.247$, $p = 0.213$; cat lovers: estimate = 0.085, $t =$
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36 243 1.640, $p = 0.101$).

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41 245 When we tested for the effect of viewing cats or dogs separately, priming was not a significant predictor in
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43 246 any of these three models. Nevertheless, the interaction between priming by cats and gender in the model
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45 247 with optimism as dependent variable turned out significant (estimate = 0.150, $t = 3.667$, $p < 0.001$, difference
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47 248 in WAIC of this model and corresponding model without the priming–gender interaction: 11.004

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49 249). It seems therefore that a viewing of cat images had a negative effect on women and a positive effect on
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51 250 men. Viewing of images of dogs had a similar effect but smaller and the interaction was not significant.
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53 251 Additionally, older people who viewed cats were more pessimistic than their younger counterparts (estimate
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55 252 = -0.005, $t = -2.775$, $p = 0.005$). Additionally, we found that encoding the desire to have children as a binary
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57 253 variable did not significantly affect the results (desire to have children: estimate = -0.258, $z = -0.806$, $p =$

254 0.420; priming*age: estimate = 0.011 $z = 1.204$, $p = 0.229$; priming*gender: estimate = 0.209, $z = 1.088$, p
1 = 0.277).

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257 In all models of the exploratory part, the pattern of significant effects of gender and age was almost identical
258 to a pattern found in the corresponding models based on the whole sample. Additionally, people who like
259 cats and dogs wanted to have less children and that regardless of whether they were primed (men and liking
260 cats: tau = -0.031, statistics = -2.827, $p = 0.005$; women and liking cats: tau = -0.032, statistics = -3.185, $p =$
261 0.001; women and liking dogs: tau = -0.029, statistics = 2.884, $p = 0.004$). The only exception to this rule
262 were men who like dogs: they wanted to have more children but the interaction was not significant (tau =
263 0.006, statistics = 0.500, $p = 0.617$). Interactions between having children and keeping cats or dogs were
264 also not significant.

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266 With respect to the real number of children, people who liked cats and dogs had less children (men and liking
267 cats: tau = -0.080, statistics = -7.111, $p \ll 0.0001$; men and liking dogs: tau = -0.071, statistics = 6.313, p
268 $\ll 0.0001$; women and liking cats: tau = -0.059, statistics = -5.913, $p = p \ll 0.0001$; women and liking dogs:
269 tau = -0.097, statistics = -9.800, $p \ll 0.0001$). In contrast, people who actually kept cats and dogs had more
270 children (men and keeping cats: tau = 0.043, statistics = 3.923, $p < 0.0001$; men and keeping dogs: tau =
271 0.093, statistics = 8.601, $p \ll 0.0001$; women and keeping cats: tau = 0.066, statistics = 6.760, $p \ll 0.0001$;
272 women and keeping dogs: tau = 0.056, statistics = 5.806, $p \ll 0.0001$). Moreover, higher numbers of cats
273 or dogs in a household positively correlated with the number of children (men and number of cats: tau =
274 0.038, statistics = 3.535, $p = 0.0004$; men and number of dogs: tau = 0.089, statistics = 8.236, $p \ll 0.0001$;
275 women and number of cats: tau = 0.064, statistics = 6.556, $p \ll 0.0001$; women and number of dogs: tau =
276 0.054, statistics = 5.528, $p \ll 0.0001$). In terms of the number of children, it made no difference whether
277 respondents had a dog or a cat. The full results of the exploratory part are shown in tables S2 and S3.

278 279 **Discussion**

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281 Our results imply that priming by photos of cats and dogs had no effect on respondents' mood or desire to
282 have children. The only factor which may have been affected by priming is optimism (measured as optimism

283 index). We interpreted differences with respect to this index between primed respondents and controls as a
284 proxy for optimism in the sense of an unconscious affect (Shevrin, 2012), that is, not as a long-term or even
285 a lifelong personality trait. This is because priming cannot increase or decrease lifelong optimism or physical
286 and mental health. As expected, primed men seemed more optimistic than non-primed ones. Surprisingly, in
287 women we found the opposite pattern: primed women seemed more pessimistic than non-primed ones. The
288 effect sizes were, however, in both sexes small. In large data sets, such small effects can easily result from
289 very indirect influence of unknown variables correlated with both the dependent and independent variables.
290 According to the exploratory analysis, this effect was driven mainly by the impact which viewing of cat
291 images had on men. In this particular case, the strength of the interaction reached the formal boarder of
292 medium effect size. Since cats are, in the xxxxx anonymized for the purpose of review process
293 xxxxxx culture, perceived as feminine and nice women are in colloquial xxxxx anonymized for the
294 purpose of review process xxxxxx even called 'cats', one could speculate whether it could be because
295 men perceive cats as a kind of substitution of women. To test this hypothesis, photos of cats and dogs could
296 be replaced by photos of men and women in future studies. Generally, it seems that viewing of photographs
297 of cats and dogs had little effect on respondents' feelings, which may contradict the findings of earlier
298 studies.

299
300 The relation between watching of videos featuring cats and experienced emotions was studied by Myrick
301 (2015), in whose study respondents (n = 6795) were asked to describe their emotions before and after they
302 last watched videos with cats. "Before/After viewing cat videos and/or photos online, I felt..." statement was
303 used to get the rating of emotions on a 7-point Likert scale. Happiness, hope, and contentment (i.e. all of the
304 positive emotions included in Myrick's study) were significantly higher after than before watching cat
305 videos. This is why it may seem surprising that viewing of photographs of cats and dogs resulted in neither
306 better mood nor higher optimism in our priming experiment. This difference could be due to several factors.

307
308 Firstly, respondents in Myrick's study may have rated their emotions after watching videos as higher because
309 they felt the need to find some justification for the time they spent by this form of procrastination.
310 Alternatively, they may have unconsciously tried to 'help' the researcher to prove the tested hypothesis or

1
2 312 just believed that watching cats makes people happier. This could not happen in our study because our
3 participants were unaware of both the purpose of the experiment and of our interest in the effect of watching
4 313 cat and dog photos on viewers' mood.
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8 315 Secondly, one could hypothesize that watching of cat or dog images might have a positive effect only on
9 people who like these animals. It is likely that cat lovers constituted a vast majority of respondents in
10 316 Myrick's study because they intentionally watched cat videos in their free time. Moreover, Stewart and
11 Strickland (2013) found out that decrease of anxiety in the presence of a dog depends on whether the person
12 317 keeps a companion animal in combination with difficulty of an experimental task (i.e. the guardianship-
13 318 difficulty interaction). Therefore, we tested our models once again on subsamples of our respondents who
14 319 liked either cats or dogs. We observed no priming effect and moreover, the influence of priming in interaction
15 320 with gender on the optimism index – which was significant in our original model – was not significant in
16 321 these new models either. Since this effect as we observed it was small, its absence may have well been due
17 322 to the smaller sample size in the new models. Nevertheless, our exploratory analyses of cat and dog lover
18 323 subsets showed that the negative results were not caused by the inclusion of people who do not like cats and
19 324 dogs in our dataset.
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36 328 Another factor which might have influenced our results is that static photographs may be a less powerful
37 stimulus than videos. On the other hand, another study found a positive effect of priming by companion
38 329 animals even when participants only wrote about them (McConnell et al., 2011). A study by Brown et al.
39 330 (2016) found that the effect of viewing animals together with assigning names to them was larger than mere
40 331 viewing: this could be at least in part due to the fact that respondents spent more time watching the images
41 332 during naming. Yet in our study, cats and dogs were rated in terms of beauty and likeability, which may have
42 333 likewise kept respondents watching for a longer time (like in Brown et al.'s study. In general, we believe
43 334 that photographs of cats and dogs and the way they were presented in our study should have been a strong
44 335 enough stimulus to test the hypotheses we postulated.
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57 338 It is, however, possible that people on the internet choose specific material which affects them differently
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1 340 watch funny images and videos of kittens and puppies rather than images of adult animals, which might well
2 341 have a different effect on them (Nittono et al., 2012; Sherman et al., 2009). On the other hand, viewing and
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4 342 assigning names to cats or dogs in photographs which were not described as funny or cute still reduced
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6 343 feelings of social rejection (Brown et al., 2016), which seems to indicate that even neutral companion animal
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8 344 images can have a significant effect on human emotions. In any case, it would be interesting to repeat our
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10 345 study with 'cute' images of cats and dogs.

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14 347 To the best of our knowledge, the influence of priming by cats or dogs on the desire to have children has not
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16 348 been studied yet. Our data showed that watching cats and dogs did not decrease the desired number of
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18 349 children, although liking of cats and dogs is related to both a lower desired number of children and a lower
19
20 350 actual number of children. Companion animal keeping, on the other hand, correlated positively with a higher
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22 351 actual number of children. Relations between keeping cats or dogs and the desired number of children were
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24 352 not significant.

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29 354 Flegr, and Preiss (2019) found highly similar correlations between liking cats and dogs and the actual number
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31 355 of children. In that study, this correlation was stronger than the relation between the actual number of
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33 356 children and keeping cats and dogs but in the present study, we observed no such clear pattern. In contrast
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35 357 to our results, in Flegr, and Preiss's study (2019) women who kept cats and dogs had fewer children. The
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37 358 stronger relation between the number of children and liking cats or dogs than between the number of children
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39 359 and companion animal keeping implies that having cats or dogs does not decrease the desire to have children.
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41 360 If it did, then keeping of cats and dogs should be related with a lower number of children more than just
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43 361 liking cats and dogs. The same is suggested by a notable absence of a significant relationship between
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45 362 priming by cat and dog images and the desire to have children. Instead, having children might decrease the
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47 363 liking of companion animals, which would be also supported by the finding that childless people feel a
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49 364 stronger bond to their companion animals (Paul, 2014). On the other hand, our results do not support the
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51 365 hypothesis that companion animals are social parasites who compete with children for the same resources
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53 366 (Archer, 1997).

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59 368 *Limitations*

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2 370 Since our data were collected using an online questionnaire, we could not control the environment of our
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4 371 experiment. Our respondents could complete their questionnaires in the presence of real cats, dogs, or other
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6 372 potential stimuli, which may have led to a failure to detect existing effects. On the other hand, our sample
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8 373 size was several times larger than sample sizes used by most comparable studies. That should sufficiently
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10 374 compensate for this source of statistical noise which may have caused some false negative results in our
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12 375 study.

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17 377 Viewing images of cats and dogs when a questionnaire was presented as a calculator of partner preferences
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19 378 may have disappointed some participants and consequently led to worse mood, less optimism, and lower
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21 379 desire to have children. Nonetheless, the fact that men tend to be slightly more, not less, optimistic after
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23 380 viewing the images seems to contradict this explanation.

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27 382 *Strengths of the study*

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32 384 Most importantly, our respondents were unaware of the fact that we are testing the effects of priming by cats
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34 385 and dogs on their responses. During recruitment, we did not mention that the questionnaire includes rating
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36 386 of cat and dog photos. The questionnaire was presented as a “Calculator of partner preferences” and
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38 387 participants were asked to rate likeability and beauty of cats and dogs to learn about their own partner
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40 388 preferences. Our results are therefore most unlikely to be influenced by participants’ conscious opinions on
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42 389 the influence of cats and dogs on humans and the proportion of cats and dog lovers in our sample should not
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44 390 be markedly higher than in the general population. Other important advantages of our study include a large
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46 391 and relatively heterogeneous sample, preregistration of all hypotheses of the confirmatory part, and an
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48 392 indirect measure of one of our variables, namely the optimism index (see introduction for details).

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394 **Conclusions**

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396 In our study, which worked with an unusually large sample of respondents (n = 8,865), we found that priming
397 by photos of cats and dogs does not influence respondents' mood, optimism, or desired number of children.
398 The existence of a significant gender–priming interaction suggests that priming might affect women's
399 optimism negatively and men's positively. Practical relevance of this phenomenon is, however, debatable
400 both in the light of other results and due to its small effect size.

401

402 Our results might imply that companion animals do not negatively influence the desire to have children. It
403 rather seems that having children decreases the reported intensity of love of companion animals. This is
404 supported by absence of an effect of viewing images of cats and dogs in conjunction with the stronger
405 relationship between the number of children and liking of cats and dogs as opposed to actual keeping of cats
406 and dogs.

407

408 Our results show that the effect of priming by cats and dogs may not be as strong as previous studies
409 indicated. It has been suggested that publication bias could be responsible for the pattern observed in current
410 literature (Herzog, 2011). In this context, publication of negative results seems rather important, especially
411 when they are obtained on the basis of large datasets. Some scientists claim that in many research areas, false
412 positive results could constitute even the majority of all published studies (Ioannidis, 2005) and this could
413 be one of the main sources of the current replication crisis (Shrout, & Rodgers, 2018). We believe that studies
414 on the priming effect of companion animal images might well be a case to the point.

415

416 **Funding**

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419

420 **Acknowledgements**

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6 423 revisions of our text.
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18 543 **Figure captions**

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21 545 Figure 1: Distributions of variables used in this study. X axes represent ranges of answers for continuous
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23 546 variables (i.e.: age, optimism index, and liking of cats and dogs) or all possible values for categorical
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25 547 variables. Y axes represent the numbers of respondents. Counts of female respondents are represented by
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27 548 dark grey columns, counts of male respondents by light grey ones.
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1 Does Viewing Cats and Dogs Influence People’s Mood, Optimism and the Desire to Have Children?

2

3 Abstract

4

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6 Photos of cats and dogs are among the most popular kinds of material on the internet. Our large-scale study
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8 (n = 8,865) tested the influence of viewing cat and dog images on the desire to have children, mood, and
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10 optimism. Main effects of priming on all these three variables were insignificant both in the general
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12 population and subpopulations of cat and dog lovers. Nevertheless, a priming–gender interaction might
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14 have a slight influence on optimism in the general population. Additionally, liking of companion animals
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16 was associated with a lower number of children, whereas the keeping of animals was associated with a
17
18 higher number of children. This may indicate that animals do not decrease fertility of their keepers as
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20 previously suggested but having children decreases liking these animals. Our results showed that the effect
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22 of watching cats and dogs might be much weaker than one would expect based on previous studies.
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28 Keywords: cats, dogs, mood, optimism, desire to have children
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15Introduction

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17Many people enjoy watching photos and videos of cats and dogs on the internet. In December 2019, tag
18“#catsofinstagram” over 120.5 million times, and tag “#dogsofinstagram” about 170.7 million times. Some
19cat and dog “influencers” have several million followers on Instagram, Facebook, and YouTube (Bruner,
202019; Leskin, 2019). Moreover, it seems that in Great Britain, images of cats are even more popular than
21selfies (Williams, 2014). This raises questions why these materials are so popular and how they influence
22people.

23

24In general, people tend to believe that companion animals have a positive influence on them. Canistherapy
25and feline therapy seem to have a positive effect on emotions and they have the potential to aid the
26treatment of mental disorders (Lundqvist, Carlsson, Sjö Dahl, Theodorsson, & Lars-Åke Levin 2017;
27Nimer, & Lundahl, 2007; Tomaszewska, Bomert, & Wilkiewicz-Wawro, 2017). The presence of a cute dog
28(Aydin et al., 2011) and even just writing about a favorite companion animal (McConnell, Brown, Shoda,
29Stayton, & Martin et al., 2011), makes people feel better after experimentally induced feelings of social
30rejection. Petting a dog decreases anxiety more than petting a stuffed animal does, especially in anxious
31people (Wheeler, & Faulkner, 2015). The results of studies on companion animals’ influence on their
32keepers are, however, mixed (Herzog, 2011).

33

34Visual materials of cats and dogs seem to affect people in various ways. People tend to judge other persons
35or their offices more positively when a dog (Budge, Spicer, Jones, & George 1996; Geries-Johnson, &
36Kennedy 1995; Lockwood, 1983; Perrine, & Wells, 2016; Rossbach, & Wilson 1992; Wells, & Perrine
372001) or cat is present (Budge et al. 1996; Perrine, & Wells, 2006). Viewing of photos of cats and dogs,
38especially if people are asked to come up with names for them, provides relief from social rejection
39(Brown Hengy, & McConnell, 2016). People who regularly watch cat videos claim that their emotions
40after last watching of such material are more positive than before (Myrick, 2015). Interestingly, exposure
41to images of kittens and puppies makes people more careful when performing fine-motor tasks compared
42to exposure to images of adult cats and dogs (Nittono, Fukushima, Yano, & Moriya, 2012; Sherman, Haidt,

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43& Coan 2009). All in all, it seems that visual materials of cats and dogs have a clearly positive effect on
44people.

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46Nevertheless, studies such as those mentioned above are mostly based on relatively small sample sizes and
47sometimes can be influenced by respondents' opinions on companion animals. Moreover, negative results
48are much less likely to be published (Herzog, 2011). One thus cannot exclude the possibility of publication
49bias skewing the image of research in this field. This is why we thought it necessary to replicate previous
50positive results in an experimental study with a large sample size.

51

52In our study, we tried to avoid several potential methodological pitfalls. First of all, we carefully avoided
53any hints to the effect that we are interested in the influence of cats and dogs on people. We did not even
54mention these animals during the recruitment of our respondents. This way, we hoped to prevent
55invalidation of our results by interference with respondents' opinions about cats and dogs and their
56usefulness to people. Additionally, the steps we took should have prevented an inflated ratio of cat and dog
57lovers in our sample who might respond to our images differently than the general population. And finally,
58we preregistered our study to avoid risk of any data dredging, cherry picking, or p-value fishing artifacts.

59

60In addition to mood and optimism, we decided to also test the effect of priming by cats and dogs on the
61desire to have children. To the best of our knowledge, this relationship has not been studied yet. It has been
62shown, however, that people without children in their household are more attached to their companion
63animals (Paul, 2014). Moreover, liking of cats and dogs is related to a lower number of children (Flegr, &
64Preiss, 2019) and it has been hypothesized that companion animals might be social parasites who compete
65with children for the same resources (Archer, 1997). We have therefore hypothesized that viewing of
66images of cats and dogs might decrease the desire to have children.

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68**Materials and methods**

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70**Subjects**

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72The online questionnaire was distributed mainly by members of the xxxxx anonymized for the
73purpose of review process xxxxxx community, a group of app. 20,000 xxxxx anonymized for the
74purpose of review process xxxxxx nationals willing to take part in evolutionary psychology
75experiments. The survey was presented as a “Calculator of partner preferences”, which were computed
76based on each participant’s rating of photos of cats and dogs and shown on the last page of the survey.

77

78Participants expressed their consent to providing anonymous responses for scientific purposes and could
79ask to have their data excluded from the analysis after completing the survey. Data collection started on
80December 24, 2018 and was completed on February 3, 2019, i.e., one day after our stopping rule was
81fulfilled. The final sample consisted of 11,778 responses.

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83The project was preregistered using the OSF system (xxxxx anonymized for the purpose of review
84process xxxxxx). The project was approved by the IRB of xxxxx anonymized for the purpose of
85review process xxxxxx.

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87The questionnaire

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89The data were collected using an online survey designed in the Qualtrics environment. The questionnaire
90consisted of four parts: i) the introductory part, ii) rating of cats or dogs, iii) primed questions, and iv) the
91final part. Participants were randomly divided in two groups of the same size. One of these answered the
92priming questions before rating cats or dogs, while the other half rated cats and dogs prior to responding to
93the priming questions. Potential differences between these two groups in gender, age, dog/cat keeping, the
94number of own children, and number of children in a household were checked using t-test or contingency
95table with respect to variable type. Additionally, primed participants were randomly selected to rate either
96cats or dogs. These two randomizations were independent of each other and both were performed using
97Qualtrics built-in randomizer. The questionnaire also contained questions unrelated to this study.

98

99In the introductory part of the questionnaire, we asked participants about their age (in years), gender (“You
100were officially born as: male or female”), sexual attraction to people of the opposite and of the same sex
101(two seven-point Likert scales; 0 = definitely not, 6 = definitely yes), liking of cats and dogs “I like
102cats/dogs very much” (scale 0–100; 0 = I completely disagree, 100 = I completely agree), and four other
103questions regarding the number of cats and dogs kept currently and in the past (Flegr, & Preiss 2019).

104 In the rating part of the survey, we asked participants to rate forty photographs of cat or dog
105‘faces’ using eight-point Likert scales in terms of likeability (1 = very unlikeable, 8 = very likeable; in
106xxxxxx anonymized for the purpose of review process xxxxxxxx we used the termxxxxxx
107anonymized for the purpose of review process xxxxxxxx) and beauty (1 = very ugly, 5 = very
108beautiful; in xxxxxx anonymized for the purpose of review process xxxxxxxx). Each image was
109presented on a separate page, with both scales showing below it.

110

111 Photographs showing frontal views of cats and dogs heads were provided by xxxxxx anonymized for
112the purpose of review process xxxxxxxx several years ago for similar studies. We selected the best-
113quality photos of diverse phenotypes of both cats and dogs. We used rating instead of just viewing of
114photographs because we wanted to prevent respondents from suspecting they are being primed. Moreover,

115we needed these ratings to provide respondents with an interesting feedback about themselves at the end of
116the survey, which we promised to motivate respondents to complete our survey in their free time.

117

118In the survey, we used six primed questions. The first two concerned the desired number of sons and
119daughters (“How many sons (daughters) would you ideally like to have (in total)?”), with response taking
120the form of numbers from zero to five, where five meant five or more. These two questions about sons and
121daughters were placed within a group of four other questions about children to prevent respondents from
122realizing the actual goal of this study (which could influence their responses). The variable desired number
123of children was computed as a sum of these two variables.

124

125The remaining four priming questions were presented together at one page of the survey. These questions
126were answered on six-point Likert scales with labels on both sides: i) “I am in a better physical condition
127than other people” (0 = definitely not, 5 = definitely yes), ii) “I am in a better mental condition than other
128people” (0 = definitely not, 5 = definitely yes), iii) “How would you rate the quality of your life?” (0 =
129very bad, 5 = very good), iv) “How do you feel right now?” (0 = very miserable, 5 = very well). Response
130to the last question was interpreted as indicating actual (conscious) mood. Variable “optimism index” was
131computed for each respondent as an average z-score of responses to the first three questions mentioned
132above. Justification of the method used to compute this index is presented in the first part of the discussion.

133

134*Data filtering and statistical analyses*

135

136All data analyses were done using R. We filtered data in the same way as xxxxxx anonymized for the
137purpose of review process xxxxxx. Additionally, we filtered data from responses with average rating
138time lower than 400ms, who likely did not watch the photographs carefully.

139

140In the confirmatory part of this study, we analyzed the influence of viewing cats or dogs on i) optimism, ii)
141actual mood, and iii) the desired number of children. The first relationship was tested using general linear
142model (GLM; R package stats 3.5.2; function glm with identity link function), the latter two were explored

143using ordinal regression models, also known as cumulative link models (CLM; R package ordinal
1442018.8.25; Christensen, 2018; function clm with logit link function).

145

146Priming was coded as a binary variable, i.e., we distinguished only whether respondents were primed or
147not. Respondents' age and gender and their interactions with priming were used as covariates. Where
148necessary, we relaxed proportional odds assumption was relaxed (using the scale option).

149

150In the exploratory part, we tested the same relationships as in the confirmatory part but used subsamples of
151cat and dog lovers (i.e., liking of cats/dogs > 50 on a 100-point scale). Cat lovers primed by dogs and dog
152lovers primed by cats were not included. The relationship between the real number of children and liking
153companion animals, as well as between the real number of children and companion animals keeping was
154tested using partial Kendall correlation tests (tau; R package ppcor 1.1; Kim, 2015; function cor.test) with
155age as a covariate.

156

157*Differences between the preregistered and the implemented protocol*

158

159Our target sample size after the filtering was 5,000 respondents. Based on our previous experience, we
160supposed the number of responses before filtering should be approximately 10,000, as stated in the
161preregistration. We terminated data collection one day after our sample size reached the target size. By that
162time, however, our sample size was approximately 11,750 because of a TV interview with the
163corresponding author (where, however, neither cats or dogs nor priming was mentioned). Additionally, we
164had to exclude much fewer responses than the expected half: probably because of shortness and interesting
165topic of the questionnaire. The final sample size was therefore significantly higher than expected (8,865
166instead of 5,000).

167

168The inclusion of interaction of gender and age with priming was not explicitly mentioned in the
169preregistration, nor did we explicitly state that we would filter out the responses of people who went
170through the rating conspicuously fast. Aside from this, we extended the exploratory analysis to find an
171explanation for our unexpected results.

172

173**Results**

174

175*Descriptive statistics*

176

177The final sample consisted of 3,963 men (mean age = 36.96, SD = 11.13) and 4,902 women (mean age =
17834.44, SD = 11.14). Distributions of variables used in the models are shown in figure 1. Primed and non-
179primed respondents did not significantly differ in gender, age, or variables regarding present dog/cat
180keeping, number of own children and number of children in the household ($p > 0.083$). Internal reliability
181of three variables used in the computation of optimism index expressed as Cronbach alpha is 0.78, which is
182commonly interpreted as acceptable.

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184-----

185Figure 1 here

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187

188*The confirmatory part*

189

190In this part, we tested the following preregistered hypotheses: i) people are on average in a better mood
191after rating photos of cats or dogs than before, ii) people are on average more optimistic (i.e., they give
192higher rating to their quality of life and mental and physical health) after rating photos of cats or dogs than
193before rating them, iii) people report wanting to have fewer children after rating photos of cats or dogs than
194before rating them. All three models – i.e., GLM model with optimism index as a dependent variable and
195priming, gender, and age as independent variables, CLM with either mood or the desired number of
196children as a dependent variable and the same independent variables – explained data significantly better
197than corresponding null models with p-values lower than 0.0001. The full results of these analyses are
198shown in table S1.

199

200Actual mood

201

202Actual mood was significantly predicted neither by priming itself (estimate = 0.063, $z = 0.478$, $p = 0.6325$)
203nor by its interaction with age or gender. The only significant predictor in this model was age, where older
204people tended to be in a better mood (estimate = 0.021, $z = 8.380$, $p \ll 0.0001$).

205

206Optimism

207

208The effect of interaction between priming and gender on optimism was significant (estimate = 0.105
209, $t = 3.135$, $p = 0.002$), difference in WAIC (R package blmeco 1.4; Korner-Nievergelt et al., 2015)
210between this model and corresponding model without this interaction was 5.972. Primed women reported
211lower optimism than the controls (-0.080 vs. -0.041), while in men the direction of the effect was he
212opposite (0.028 vs. 0.075). Nevertheless, the effect sizes expressed as Cohen's d (R package effsize 0.7.6;
213Torchiano, 2020) were negligible (primed vs. non-primed men: 0.0627; non-primed vs. primed women:
214-0.050) and their 95 confidence intervals included zero (non-primed vs. primed men: -0.002 to 0.128
215; non-primed vs. primed women: -0.108 to 0.008). Generally, the optimism index was almost the same in
216the primed people and the controls (mean = -0.01, estimate = 0.059, $t = 1.057$, $p = 0.291$). The effect of
217gender itself was not significant (estimate = 0.031, $t = 1.327$, $p = 0.184$) and optimism index increased
218with respondents' age (estimate = 0.013, $t = 12.233$, $p \ll 0.0001$).

219

220Desired number of children

221

222The desired number of children did not significantly depend on either priming itself (estimate = 0.031, $z =$
2230.225, $p = 0.822$) or its interaction with one of the covariates. It did, however, significantly depend on age
224and gender. Older people wanted to have more children than younger people did (estimate = 0.019, z
225=7.359, $p \ll 0.0001$) and men wanted to have more children than women did (estimate = 0.242, $z = 4.126$,
226 $p < 0.0001$).

227

228 *The exploratory part*

229

230 In the exploratory part, we tested relationships between the same variables as in the confirmatory part. In
231 the first model, however, we analyzed data from respondents who liked cats (1,547 men and 2,478 women)
232 or dogs (1,889 men and women 2,757) separately, that is, we tested only subsamples of responders who
233 rated their liking of cats or dogs at least by 50 points on the 0–100 scale. In the second model, priming was
234 not encoded as a binary variable as in the previous models. Instead, it had three values: “cats”, “dogs”, or
235 “none”. In another model, we encoded the desire to have children as a binary variable, that is, we
236 compared respondents who do not want any children with respondents who want at least one child.
237 Additionally, we tested the relationship between liking or keeping cats and dogs and both the real and the
238 desired number of children.

239

240 Regarding the data from cat and dog lovers, neither the effect of priming nor its interaction with age or
241 gender were significant in any of these models. Even the effect of interaction of priming and gender on the
242 optimism index, which was significant in a model based on the whole dataset, became insignificant in both
243 models based on subpopulations (dog lovers: 0.060, $t = 1.247$, $p = 0.213$; cat lovers: estimate = 0.085, $t =$
244 1.640, $p = 0.101$).

245

246 When we tested for the effect of viewing cats or dogs separately, priming was not a significant predictor in
247 any of these three models. Nevertheless, the interaction between priming by cats and gender in the model
248 with optimism as dependent variable turned out significant (estimate = 0.150, $t = 3.667$, $p < 0.001$,
249 difference in WAIC of this model and corresponding model without the priming–gender interaction: 11.004
250). It seems therefore that a viewing of cat images had a negative effect on women and a positive effect on
251 men. Viewing of images of dogs had a similar effect but smaller and the interaction was not significant.
252 Additionally, older people who viewed cats were more pessimistic than their younger counterparts
253 (estimate = -0.005, $t = -2.775$, $p = 0.005$). Additionally, we found that encoding the desire to have children
254 as a binary variable did not significantly affect the results (desire to have children: estimate = -0.258, $z =$

1 255-0.806, $p = 0.420$; priming*age: estimate = 0.011 $z = 1.204$, $p = 0.229$; priming*gender: estimate = 0.209, z
2 256= 1.088, $p = 0.277$).

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6 258In all models of the exploratory part, the pattern of significant effects of gender and age was almost
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8 259identical to a pattern found in the corresponding models based on the whole sample. Additionally, people
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10 260who like cats and dogs wanted to have less children and that regardless of whether they were primed (men
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12 261and liking cats: tau = -0.031, statistics = -2.827, $p = 0.005$; women and liking cats: tau = -0.032, statistics =
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14 262-3.185, $p = 0.001$; women and liking dogs: tau = -0.029, statistics = 2.884, $p = 0.004$). The only exception
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16 263to this rule were men who like dogs: they wanted to have more children but the interaction was not
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18 264significant (tau = 0.006, statistics = 0.500, $p = 0.617$). Interactions between having children and keeping
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20 265cats or dogs were also not significant.

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25 267With respect to the real number of children, people who liked cats and dogs had less children (men and
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27 268liking cats: tau = -0.080, statistics = -7.111, $p \ll 0.0001$; men and liking dogs: tau = -0.071, statistics =
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29 2696.313, $p \ll 0.0001$; women and liking cats: tau = -0.059, statistics = -5.913, $p = p \ll 0.0001$; women and
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31 270liking dogs: tau = -0.097, statistics = -9.800, $p \ll 0.0001$). In contrast, people who actually kept cats and
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33 271dogs had more children (men and keeping cats: tau = 0.043, statistics = 3.923, $p < 0.0001$; men and
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35 272keeping dogs: tau = 0.093, statistics = 8.601, $p \ll 0.0001$; women and keeping cats: tau = 0.066, statistics
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37 273= 6.760, $p \ll 0.0001$; women and keeping dogs: tau = 0.056, statistics = 5.806, $p \ll 0.0001$). Moreover,
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39 274higher numbers of cats or dogs in a household positively correlated with the number of children (men and
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41 275number of cats: tau = 0.038, statistics = 3.535, $p = 0.0004$; men and number of dogs: tau = 0.089, statistics
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43 276= 8.236, $p \ll 0.0001$; women and number of cats: tau = 0.064, statistics = 6.556, $p \ll 0.0001$; women and
44
45 277number of dogs: tau = 0.054, statistics = 5.528, $p \ll 0.0001$). In terms of the number of children, it made
46
47 278no difference whether respondents had a dog or a cat. The full results of the exploratory part are shown in
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49 279tables S2 and S3.

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281 Discussion

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3
4 283 Our results imply that priming by photos of cats and dogs had no effect on respondents' mood or desire to
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6 284 have children. The only factor which may have been affected by priming is optimism (measured as
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8 285 optimism index). We interpreted differences with respect to this index between primed respondents and
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10 286 controls as a proxy for optimism in the sense of an unconscious affect (Shevrin, 2012), that is, not as a
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12 287 long-term or even a lifelong personality trait. This is because priming cannot increase or decrease lifelong
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14 288 optimism or physical and mental health. As expected, primed men seemed more optimistic than non-
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16 289 primed ones. Surprisingly, in women we found the opposite pattern: primed women seemed more
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18 290 pessimistic than non-primed ones. The effect sizes were, however, in both sexes small. In large data sets,
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20 291 such small effects can easily result from very indirect influence of unknown variables correlated with both
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22 292 the dependent and independent variables. According to the exploratory analysis, this effect was driven
23
24 293 mainly by the impact which viewing of cat images had on men. In this particular case, the strength of the
25
26 294 interaction reached the formal boarder of medium effect size. Since cats are, in the xxxxx anonymized
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28 295 for the purpose of review process xxxxxxx culture, perceived as feminine and nice women are in
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30 296 colloquial xxxxx anonymized for the purpose of review process xxxxxxx even called 'cats', one
31
32 297 could speculate whether it could be because men perceive cats as a kind of substitution of women. To test
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34 298 this hypothesis, photos of cats and dogs could be replaced by photos of men and women in future studies.
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36 299 Generally, it seems that viewing of photographs of cats and dogs had little effect on respondents' feelings,
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38 300 which may contradict the findings of earlier studies.
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44 301

45 302 The relation between watching of videos featuring cats and experienced emotions was studied by Myrick
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47 303 (2015), in whose study respondents (n = 6795) were asked to describe their emotions before and after they
48
49 304 last watched videos with cats. "Before/After viewing cat videos and/or photos online, I felt..." statement
50
51 305 was used to get the rating of emotions on a 7-point Likert scale. Happiness, hope, and contentment (i.e. all
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53 306 of the positive emotions included in Myrick's study) were significantly higher after than before watching
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55 307 cat videos. This is why it may seem surprising that viewing of photographs of cats and dogs resulted in
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308neither better mood nor higher optimism in our priming experiment. This difference could be due to
309several factors.

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311Firstly, respondents in Myrick’s study may have rated their emotions after watching videos as higher
312because they felt the need to find some justification for the time they spent by this form of procrastination.

313Alternatively, they may have unconsciously tried to ‘help’ the researcher to prove the tested hypothesis or
314just believed that watching cats makes people happier. This could not happen in our study because our
315participants were unaware of both the purpose of the experiment and of our interest in the effect of
316watching cat and dog photos on viewers’ mood.

317

318Secondly, one could hypothesize that watching of cat or dog images might have a positive effect only on
319people who like these animals. It is likely that cat lovers constituted a vast majority of respondents in
320Myrick’s study because they intentionally watched cat videos in their free time. Moreover, Stewart and
321Strickland (2013) found out that decrease of anxiety in the presence of a dog depends on whether the
322person keeps a companion animal in combination with difficulty of an experimental task (i.e. the
323guardianship-difficulty interaction). Therefore, we tested our models once again on subsamples of our
324respondents who liked either cats or dogs. We observed no priming effect and moreover, the influence of
325priming in interaction with gender on the optimism index – which was significant in our original model –
326was not significant in these new models either. Since this effect as we observed it was small, its absence
327may have well been due to the smaller sample size in the new models. Nevertheless, our exploratory
328analyses of cat and dog lover subsets showed that the negative results were not caused by the inclusion of
329people who do not like cats and dogs in our dataset.

330

331Another factor which might have influenced our results is that static photographs may be a less powerful
332stimulus than videos. On the other hand, another study found a positive effect of priming by companion
333animals even when participants only wrote about them (McConnell et al., 2011). A study by Brown et al.
334(2016) found that the effect of viewing animals together with assigning names to them was larger than
335mere viewing: this could be at least in part due to the fact that respondents spent more time watching the
336images during naming. Yet in our study, cats and dogs were rated in terms of beauty and likeability, which

1
2 337may have likewise kept respondents watching for a longer time (like in Brown et al.'s study. In general, we
3
4 338believe that photographs of cats and dogs and the way they were presented in our study should have been a
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6 339strong enough stimulus to test the hypotheses we postulated.

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341It is, however, possible that people on the internet choose specific material which affects them differently
342than the relatively neutral images of cats or dogs such as were presented by us. For example, people may
343watch funny images and videos of kittens and puppies rather than images of adult animals, which might
344well have a different effect on them (Nittono et al., 2012; Sherman et al., 2009). On the other hand,
345viewing and assigning names to cats or dogs in photographs which were not described as funny or cute still
346reduced feelings of social rejection (Brown et al., 2016), which seems to indicate that even neutral
347companion animal images can have a significant effect on human emotions. In any case, it would be
348interesting to repeat our study with 'cute' images of cats and dogs.

349

350To the best of our knowledge, the influence of priming by cats or dogs on the desire to have children has
351not been studied yet. Our data showed that watching cats and dogs did not decrease the desired number of
352children, although liking of cats and dogs is related to both a lower desired number of children and a lower
353actual number of children. Companion animal keeping, on the other hand, correlated positively with a
354higher actual number of children. Relations between keeping cats or dogs and the desired number of
355children were not significant.

356

357Flegr, and Preiss (2019) found highly similar correlations between liking cats and dogs and the actual
358number of children. In that study, this correlation was stronger than the relation between the actual number
359of children and keeping cats and dogs but in the present study, we observed no such clear pattern. In
360contrast to our results, in Flegr, and Preiss's study (2019) women who kept cats and dogs had fewer
361children. The stronger relation between the number of children and liking cats or dogs than between the
362number of children and companion animal keeping implies that having cats or dogs does not decrease the
363desire to have children. If it did, then keeping of cats and dogs should be related with a lower number of
364children more than just liking cats and dogs. The same is suggested by a notable absence of a significant
365relationship between priming by cat and dog images and the desire to have children. Instead, having

1
2 366children might decrease the liking of companion animals, which would be also supported by the finding
3 367that childless people feel a stronger bond to their companion animals (Paul, 2014). On the other hand, our
4 368results do not support the hypothesis that companion animals are social parasites who compete with
5 369children for the same resources (Archer, 1997).

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10 **371Limitations**

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14 373Since our data were collected using an online questionnaire, we could not control the environment of our
15 374experiment. Our respondents could complete their questionnaires in the presence of real cats, dogs, or
16 375other potential stimuli, which may have led to a failure to detect existing effects. On the other hand, our
17 376sample size was several times larger than sample sizes used by most comparable studies. That should
18 377sufficiently compensate for this source of statistical noise which may have caused some false negative
19 378results in our study.

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28 380Viewing images of cats and dogs when a questionnaire was presented as a calculator of partner preferences
29 381may have disappointed some participants and consequently led to worse mood, less optimism, and lower
30 382desire to have children. Nonetheless, the fact that men tend to be slightly more, not less, optimistic after
31 383viewing the images seems to contradict this explanation.

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40 **385Strengths of the study**

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44 387Most importantly, our respondents were unaware of the fact that we are testing the effects of priming by
45 388cats and dogs on their responses. During recruitment, we did not mention that the questionnaire includes
46 389rating of cat and dog photos. The questionnaire was presented as a “Calculator of partner preferences” and
47 390participants were asked to rate likeability and beauty of cats and dogs to learn about their own partner
48 391preferences. Our results are therefore most unlikely to be influenced by participants’ conscious opinions on
49 392the influence of cats and dogs on humans and the proportion of cats and dog lovers in our sample should
50 393not be markedly higher than in the general population. Other important advantages of our study include a

1
2 394large and relatively heterogeneous sample, preregistration of all hypotheses of the confirmatory part, and
3 395an indirect measure of one of our variables, namely the optimism index (see introduction for details).

4 396

5
6 397**Conclusions**

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11 399In our study, which worked with an unusually large sample of respondents ($n = 8,865$), we found that
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13 400priming by photos of cats and dogs does not influence respondents' mood, optimism, or desired number of
14
15 401children. The existence of a significant gender–priming interaction suggests that priming might affect
16
17 402women's optimism negatively and men's positively. Practical relevance of this phenomenon is, however,
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19 403debatable both in the light of other results and due to its small effect size.

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24 405Our results might imply that companion animals do not negatively influence the desire to have children. It
25
26 406rather seems that having children decreases the reported intensity of love of companion animals. This is
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28 407supported by absence of an effect of viewing images of cats and dogs in conjunction with the stronger
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30 408relationship between the number of children and liking of cats and dogs as opposed to actual keeping of
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32 409cats and dogs.

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37 411Our results show that the effect of priming by cats and dogs may not be as strong as previous studies
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39 412indicated. It has been suggested that publication bias could be responsible for the pattern observed in
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41 413current literature (Herzog, 2011). In this context, publication of negative results seems rather important,
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43 414especially when they are obtained on the basis of large datasets. Some scientists claim that in many
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45 415research areas, false positive results could constitute even the majority of all published studies (Ioannidis,
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47 4162005) and this could be one of the main sources of the current replication crisis (Shrout, & Rodgers, 2018).
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49 417We believe that studies on the priming effect of companion animal images might well be a case to the
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51 418point.

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549**Figure captions**

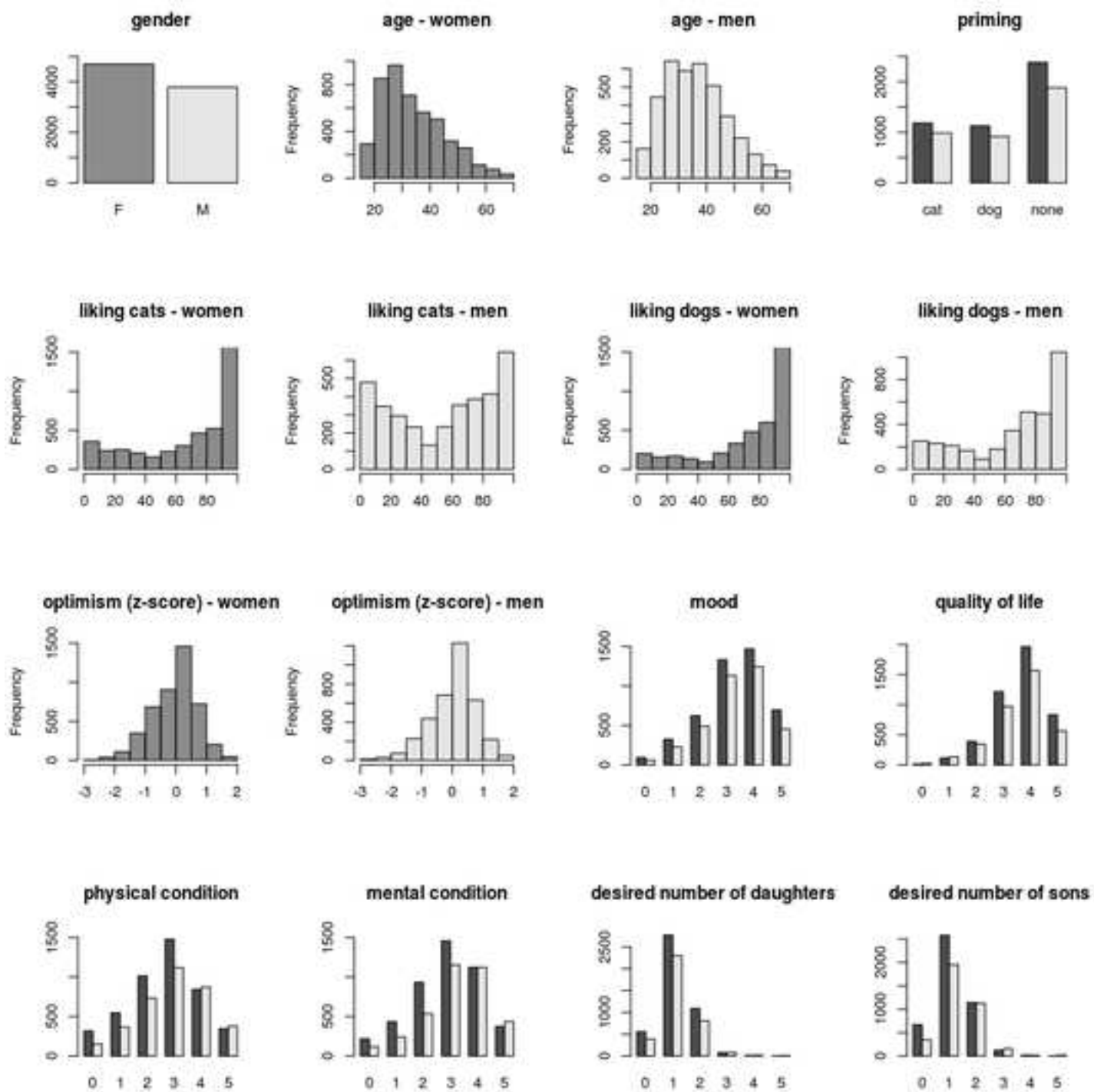
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551Figure 1: Distributions of variables used in this study. X axes represent ranges of answers for continuous

552variables (i.e.: age, optimism index, and liking of cats and dogs) or all possible values for categorical

553variables. Y axes represent the numbers of respondents. Counts of female respondents are represented by

554dark grey columns, counts of male respondents by light grey ones.



The results of all models used in the confirmatory analyses.

mood				
variable	estimate	std. error	z value	p value
priming	0.062506	0.130706	0.478	0.6325
age	0.020705	0.002471	8380	<2e-16
gender	-0.096156	0.053971	-1782	0.0748
priming*age	-0.003309	0.003469	-0.954	0.3401
priming*gender	0.040349	0.076969	0.524	0.6001

optimism				
variable	estimate	std. error	t value	p value
priming	0.058945	0.055782	1,057	0.29068
age	0.012745	0.001042	12,233	< 2e-16
gender	0.030936	0.023308	1,327	0.18445
priming*age	-0.003039	0.001486	-2,046	0.14080
priming*gender	0.105251	0.033572	3,135	0.00172

desire to have children				
variable	estimate	std. error	z value	p value
priming	0.031467	0.139661	0.225	0.822
age	0.019190	0.002608	7,359	1.86e-13
gender	0.242384	0.058740	4,126	3.69e-05
priming*age	0.002347	0.003694	0.635	0.525
priming*gender	-0.059445	0.084044	-0.707	0.479

The results of the exploratory models. glm model was

Mood: dog lovers				
variable	estimate	std. error	z value	p value
priming	.0984651	.1899257	-0.518	0.604
age	.0215615	.0029422	7328	2.33e-13
gender	.0317930	.0637016	-0.499	0.618
priming*age	.0005194	.0051328	-0.101	0.919
priming*gender	.0383341	.1123308	0.341	0.733

Mood: cat lovers				
variable	estimate	std. error	z value	p value
priming	0.096655	0.202882	0.476	0.634
age	0.020483	0.003195	6410	1.45e-10
gender	-0.077716	0.072092	-1078	0.281
priming*age	-0.001414	0.005502	-0.257	0.797
priming*gender	-0.109510	0.126283	-0.867	0.386

Optimism: dog lovers				
variable	estimate	std. error	z value	p value
priming	.0161431	.0794806	-0.203	0.839
age	.0128721	.0012133	10609	<2e-16
gender	.0298238	.0270983	1101	0.271
priming*age	.0009014	.0021546	-0.418	0.676
priming*gender	.0601898	.0482723	1247	0.213

Optimism: cat lovers				
variable	estimate	std. error	z value	p value
priming	0.063559	0.082168	0.774	0.439
age	0.013199	0.001284	10280	<2e-16
gender	0.047721	0.029608	1612	0.107
priming*age	-0.002782	0.002210	-1259	0.208
priming*gender	0.084783	0.051704	1640	0.101

Desire to have children: dog lovers				
variable	estimate	std. error	z value	p value
priming	-0.313665	0.222522	-1410	0.1587
age	0.017292	0.003468	4987	6.14e-07
gender	0.314819	0.076988	4089	4.33e-05
priming*age	0.010509	0.006080	1729	0.0839
priming*gender	-0.087917	0.134453	-0.654	0.5132

Desire to have children: cat lovers				
variable	estimate	std. error	z value	p value
priming	.0375114	.2083292	-0.180	0.8571
age	.0174856	.0032675	5351	8.73e-08
gender	.1569755	.0755399	2078	0.0377

priming*age	.0038769	.0055626	0.697	0.4858
priming*gender	.0002042	.1307890	-0.002	0.9988

Mood: separate encoding of priming by cats and by dogs				
variable	estimate	std. error	z value	p value
priming-cat	.1804779	.1645435	1.097	0.2727
priming-dog	.1039285	.1698075	-0.612	0.5405
age	.0213524	.0025421	8400	<2e-16
gender	.0945837	.0560928	-1.686	0.0918
priming-cat*age	.0049194	.0043814	-1.123	0.2615
priming-dog*age	.0005448	.0045049	-0.121	0.9037
priming-cat*gender	.0211816	.0981293	0.216	0.8291
priming-dog*gender	.0630414	.1003297	0.628	0.5298

Optimism: separate encoding of priming by cats and by dogs				
variable	estimate	std. error	z value	p value
priming-cat	.1147564	.0677380	1.694	0.090280
priming-dog	.0033256	.0698201	-0.048	0.962011
age	.0127447	.0010416	12.236	< 2e-16
gender	.0309364	.0233018	1.328	0.184335
priming-cat*age	.0049870	.0017972	-2.775	0.005536
priming-dog*age	.0008972	.0018530	-0.484	0.628271
priming-cat*gender	.1501139	.0409317	3.667	0.000247
priming-dog*gender	.0571562	.0417965	1.367	0.171510

Desire: separate encoding of priming by cats and by dogs				
variable	estimate	std. error	z value	p value
priming-cat	.0263308	.0582759	0.452	0.65139
priming-dog	.0402052	.0606220	-0.663	0.50720
age	.0051188	.0008844	5788	7.12e-09
genderM	.0610243	.0200964	3.037	0.00239
primingcat:age	.0001064	.0015128	0.070	0.94395
priming-dog:age	.0013601	.0015676	0.868	0.38561
priming-cat:gender	.0011039	.0348963	-0.032	0.97476
priming-dog:gender	.0077700	.0359540	-0.216	0.82890

Binnary encoded desire to have children				
variable	estimate	std. error	z value	p value
priming	-0.258438	0.320554	-0.806	0.420
age	0.027697	0.006202	4.466	7.96e-06
gender	-0.023467	0.126388	-0.186	0.853
priming*age	0.011443	0.009508	1.204	0.229
priming*gender	0.209468	0.192565	1.088	0.277

Correlation tests of the number of own children and companion			
variable	estimate	p. value	statistic
liking of dogs	-0.09708596	1.126133e-22	-9.799975
at least one dog is present in	0.05629433	6.377562e-09	5.806544
number of dogs in household	0.05359314	3.240384e-08	5.527926
liking of cats	-0.05856139	3.354928e-09	-5.913215
at least one cat is present in	0.06551588	0.0000001381	6.759855
number of cats in household	0.06354326	0.0000551511	6.556322

Correlation tests of the number of own children and companion			
variable	estimate	p. value	statistic
liking of dogs	-0.07066503	2.731278e-10	-6.313311
at least one dog is present in	0.09339591	7.885886e-18	8.601241
number of dogs in household	0.08942954	1.781225e-16	8.235961
liking of cats	-0.079761	1.144709e-12	-7.111882
at least one cat is present in	0.04259246	8.76249e-05	3.922527
number of cats in household	0.0383843	0.0004078072	3.534979

Correlation tests of the number of desired children and companion			
variable	estimate	p. value	statistic
liking of dogs	-0.02864935	0.003931751	-2.883586
at least one dog is present in	0.01863908	0.05517952	1.91746
number of dogs in household	0.01767331	0.06904747	1.818109
liking of cats	-0.03162618	0.001445903	-3.185327
at least one cat is present in	0.01739664	0.0734189	1.790218
number of cats in household	0.01757372	0.07053813	1.808439

Correlation tests of the number of desired children and companion			
variable	estimate	p. value	statistic
liking of dogs	0.00561207	0.6168435	0.5003289
at least one dog is present in	0.0258843	0.01740204	2.378101
number of dogs in household	0.02476974	0.02286388	2.275702
liking of cats	-0.0317877	0.004685115	-2.827922
at least one cat is present in	-0.002593451	0.8116706	-0.2382714
number of cats in household	-0.004569714	0.674603	-0.4198391

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Method