

Northumbria Research Link

Citation: Saxton, Tamsin, Pollet, Thomas, Panagakis, Jenny, Round, Emily, Brown, Samantha and Lobmaier, Janek S. (2020) Children aged 7-9 prefer cuteness in baby faces, and femininity in women's faces. *Ethology*, 126 (11). pp. 1048-1060. ISSN 0179-1613

Published by: Wiley-Blackwell

URL: <https://doi.org/10.1111/eth.13081> <<https://doi.org/10.1111/eth.13081>>

This version was downloaded from Northumbria Research Link:
<http://nrl.northumbria.ac.uk/id/eprint/43876/>

Northumbria University has developed Northumbria Research Link (NRL) to enable users to access the University's research output. Copyright © and moral rights for items on NRL are retained by the individual author(s) and/or other copyright owners. Single copies of full items can be reproduced, displayed or performed, and given to third parties in any format or medium for personal research or study, educational, or not-for-profit purposes without prior permission or charge, provided the authors, title and full bibliographic details are given, as well as a hyperlink and/or URL to the original metadata page. The content must not be changed in any way. Full items must not be sold commercially in any format or medium without formal permission of the copyright holder. The full policy is available online: <http://nrl.northumbria.ac.uk/policies.html>

This document may differ from the final, published version of the research and has been made available online in accordance with publisher policies. To read and/or cite from the published version of the research, please visit the publisher's website (a subscription may be required.)



**Northumbria
University**
NEWCASTLE



UniversityLibrary

This is the author-accepted version of:

Saxton, TK, Pollet, TV, Panagakis, J, Round, EK, Brown, SE, Lobmaier, JS. (in press)
Children aged 7–9 prefer cuteness in baby faces, and femininity in women's faces.
Ethology. <https://doi.org/10.1111/eth.13081>

Please refer to the published article for the final version.

1

2 **Children aged 7 – 9 prefer cuteness in baby faces, and femininity in women's**
3 **faces**

4

5 Tamsin K. Saxton ^{*a}, Thomas V. Pollet ^a, Jenny Panagakis ^a, Emily K. Round ^a, Samantha E.
6 Brown ^a, Janek S. Lobmaier ^b

7

8 ^a Psychology Department, Northumbria University, Newcastle, NE8 2GR, United Kingdom.

9 ^b University of Bern, Institute of Psychology, Department of Social Neuroscience and Social

10 Psychology, Fabrikstrasse 8, 3012 Bern, Switzerland

11 * corresponding author

12

13

14 **Acknowledgements**

15

16 We thank our participants.

17

18

19 **Abstract**

20

21 Infant facial features are typically perceived as 'cute', provoking caretaking behaviours. Previous
22 research has focused on adults' perceptions of baby cuteness, and examined how these
23 perceptions are influenced by events of the adult reproductive lifespan, such as ovulation and
24 menopause. However, globally, individuals of all ages, including prepubertal children, provide
25 notable proportions of infant care. In this study, we recruited participants in and around northern
26 England, and tested 330 adults and 65 children aged 7 – 9 using a forced-choice paradigm to
27 assess preferences for infant facial cuteness in two stimulus sets, and (as a control task)

28 preferences for femininity in women's faces. We analysed the data with Hierarchical Bayesian
29 Regression Models. The adults and children successfully identified infants that had been
30 manipulated to appear cuter, although children's performance was poorer than adults, and
31 children reliably identified infant cuteness in only one of the two infant stimuli sets. Children
32 chose the feminised over masculinised women's faces as more attractive, although again their
33 performance was poorer than adults'. There was evidence for a female advantage in the tasks:
34 girls performed better than boys when assessing the woman stimuli and one of the infant
35 stimulus sets, and women performed better than men when assessing one of the infant stimulus
36 sets. There was no evidence that cuteness judgements differed depending upon exposure to
37 infants (children with siblings aged 0 - 2; adults with a baby caregiving role), or depending upon
38 being just younger or older than the average age of menopause. Children and grandparents
39 provide notable portions of infant caretaking globally, and cuteness perceptions could direct
40 appropriate caregiving behaviour in these age groups, as well as in adults of reproductive age.

41

42 Keywords: attractiveness; development; face perception; facial cuteness; facial femininity;
43 Kindchenschema

44

45

46 **1 Introduction**

47

48 The appeal of babies has been the subject of extensive research, predominantly focused
49 around infants' visual appearance (Kringelbach, Stark, Alexander, Bornstein, & Stein, 2016).
50 Infant facial features such as protruding cheeks, a large forehead, and large eyes make up the
51 infant 'Kindchenschema' (Lorenz, 1943), which precipitates assessments of 'cuteness' (Alley,
52 1981; Glocker et al., 2009; Hildebrandt & Fitzgerald, 1979b; Hückstedt, 1965; Little, 2012).
53 These infantile facial features are powerful and salient. They activate reward systems in the
54 brain (review in Hahn & Perrett, 2014), provoke behavioural care (review in Kringelbach et al.,
55 2016), and automatically capture attention and induce physiological responses in both familiar
56 and less familiar faces (Brosch, Sander, & Scherer, 2007; Esposito et al., 2014; Proverbio, Riva,
57 Zani, & Martin, 2011). Reactions to infant features carry over into other domains, shaping our
58 reactions to other species (e.g. Golle, Probst, Mast, & Lobmaier, 2015; Little, 2012), to
59 'babyfaced' adults (see e.g. Zebrowitz & Montepare, 1992), and to inanimate objects (e.g. Hinde
60 & Barden, 1985), with far-reaching implications for many aspects of contemporary culture,
61 including marketing and social media (Dale, Goggin, Leyda, McIntyre, & Negra, 2016).

62

63 At what point in development do children become attuned to the facial cues to baby cuteness
64 that adults attend to so reliably? Children aged 2 – 6 years demonstrated some preferences for
65 kittens and puppies compared to adult cats and dogs, as well as for infantile facial features in
66 kittens and teddy bears (Borgi & Cirulli, 2013). Six and 8-year-olds, but not 4-year-olds,
67 preferred baby-faced over adult-faced teddy bears (Morris, Reddy, & Bunting, 1995). These two
68 studies indicate that children are alert to differences in infantile features, although the small
69 numbers of stimuli that were employed ($n = 18$ photographs in the former study, and $n = 8$ teddy
70 bears in the latter) differed in ways other than just infantile features (e.g. the former study
71 compared preferences for photographs of 2 teddy bears with infant features against
72 photographs of 2 teddy bears without infant features, but the teddy bears also differed in colour
73 etc). Another study (Borgi, Cogliati-Dezza, Brelsford, Meints, & Cirulli, 2014) presented children
74 (aged 3 – 6) and adults with images of adult and infant dogs, cats, and humans, all of which had
75 been manipulated to be higher or lower in infantile features. In a forced-choice test, overall, the
76 children spent more time looking at the stimuli with the infantile features, but this seemed to be
77 mainly driven by their attention to infantile features in adult faces. When the adults and children
78 were asked to rate the images for cuteness, they gave higher ratings to infantile faces than non-
79 infantile faces, but adults rated faces of infants as cuter than faces of the adults across all three
80 species, whereas children did not differentiate those categories. A final study (Sanefuji, Ohgami,
81 & Hashiya, 2007) asked children of around 5 years of age and adults to rank order the cuteness
82 of pictures of infants of different ages from 5 different species. Children and adults created
83 ranking orders that demonstrated some similarities (e.g. both groups considered the 3-month-
84 old human babies to be cuter than the 18-month-old human babies). These studies therefore
85 provide converging evidence that infantile features influence judgements in early childhood,
86 even if the patterns of children's judgements do not exactly mirror those of adults.

87

88 However, pre-pubertal children are less attuned to some facial features that affect adults'
89 evaluative judgements (Boothroyd, Meins, Vukovic, & Burt, 2014; Saxton, Caryl, & Roberts,
90 2006; Saxton, DeBruine, Jones, Little, & Roberts, 2009), and we could infer that they might also
91 be relatively insensitive to subtle facial cues of infant cuteness. Some literature has focussed on
92 how baby cuteness perceptions are shaped by the impact of sex hormones and events such as
93 ovulation and menopause (Luo, Ma, et al., 2015), working on the basis that cuteness perception
94 is most relevant to individuals during their reproductive lifespan. Thus, we find one study
95 reporting that girls aged 12 – 13 had stronger preferences for pictures of infants over pictures of

96 adults if the girls were postmenarchal rather than premenarchal (Goldberg, Blumberg, & Kriger,
97 1982), although another study of girls aged 10 – 15 reported that their interest in interacting with
98 infants declined with age and menarchal status (Frodi, Murray, Lamb, & Steinberg, 1984). In
99 terms of reacting to cues of infant cuteness specifically, women who were younger than the
100 average age of menopause, or pre-menopausal, were better at detecting infant cuteness than
101 women over the average age of menopause, or post-menopausal (Sprengelmeyer et al., 2009).
102 There is some evidence that people with raised levels of artificial reproductive hormones (i.e.
103 users of hormonal contraceptives) are more sensitive to infant facial cuteness ((Sprengelmeyer
104 et al., 2009); but see (Sprengelmeyer, Lewis, Hahn, & Perrett, 2013)). Other researchers have
105 indicated that testosterone levels rather than estradiol or progesterone levels are better at
106 explaining differential sensitivity to infant facial cuteness (Hahn, DeBruine, Fisher, & Jones,
107 2015). Women were found to be better able to discriminate between high- and low-cuteness
108 versions of infant faces around ovulation (Lobmaier, Probst, Perrett, & Heinrichs, 2015),
109 although, perhaps unsurprisingly, such ovulatory-linked shifts were not apparent in a smaller
110 sample (Sprengelmeyer et al., 2013). Irrespective, face processing behaviour is shaped by
111 hormones (review in Scherf, 2012), indicating one plausible mechanism for differences between
112 adults and children in sensitivity to cuteness cues.

113

114 On the other hand, caregiving behaviour that is motivated by baby cuteness seems functionally
115 significant even in childhood. In many societies and cultures, and across history, from early
116 childhood onwards, siblings and other children (particularly females) are often involved in infant
117 caretaking (Weisner, 1987; Weisner et al., 1977). A survey (Weisner et al., 1977) of 186
118 societies, which were selected to have fairly rich ethnographic data available and to be
119 representative of the different cultures worldwide, reported that, in the 162 samples that could
120 be coded, the mother acted as infant caretaker either almost exclusively or principally in 86
121 societies, but people other than the mother had at least an important role (or, in a small number
122 of cases, rivalled the mother's care) in 76 societies. These caretakers were most likely to be
123 specified as adults or others including employees in 92 societies, and as children in the
124 remaining 46 societies that could be coded. That is, childhood caretaking of infants is not the
125 dominant mode, but it is far from insignificant. Children may well be acting as infant caretakers
126 from the age of 7, if not even younger (Weisner, 1987; Weisner et al., 1977), something that has
127 also been noted in hunter-gatherer societies (Hewlett & Lamb, 2017), which are often seen as
128 an approximate model for standard patterns of human existence in former eras. The functional
129 significance of adults' cuteness perceptions, which could provoke appropriate caregiving (Hahn

130 & Perrett, 2014), also then seems relevant to children's cuteness perceptions. Thus, it is
131 relevant to ask whether or to what extent pre-pubertal children detect and respond to infant
132 cuteness. The developmental trajectory of cuteness perception has been identified as one of the
133 key outstanding questions within this area (Kringelbach et al., 2016). Further, studying the
134 developmental trajectory of face perceptions helps us understand the development of cognitive
135 abilities and the origins of facial evaluations, and allows us to better map psychological
136 adaptations (Archer, 2019).

137
138 Accordingly, we set out to determine whether children aged 7 – 9 can distinguish subtle facial
139 cues of infant cuteness, and how their judgements compared with those of adults. Children
140 aged 7 – 9 were chosen because they have been shown to differ from adults in terms of their
141 judgements of several facial cues (Boothroyd et al., 2014), which might imply they would also be
142 poor at detecting infant facial cuteness. On the other hand, children are frequently acting as
143 caretakers of infant by age 7 – 9 (Weisner, 1987; Weisner et al., 1977), such that a functional
144 explanation would predict that they would respond to infant facial cuteness. As a control task,
145 we asked the participants to evaluate the attractiveness of female faces that differed in
146 femininity, given that previous research has demonstrated extensively that adults find femininity
147 attractive in female faces (Rhodes, 2006; Thornhill & Gangestad, 1999), whereas female facial
148 femininity does not appear to be reliably perceived as attractive by children in the 7 – 9 age
149 group (Boothroyd et al., 2014).

150
151 Alongside the general age-linked development of facial evaluations, there may also be
152 important individual differences in face judgements, contingent upon individual variables.
153 Consistent with the greater infant caretaking role of females than males on average, women
154 have been reported as more sensitive than men to subtle differences in infant facial cuteness,
155 whereas women and men were equally competent at judging infant age and happiness
156 (Lobmaier, Sprengelmeyer, Wiffen, & Perrett, 2010; Sprengelmeyer et al., 2009), and
157 accordingly, we compared male and female judgements in our study. Sibling status alters
158 evaluative judgements of others in adaptive ways (Lieberman, Tooby, & Cosmides, 2007), while
159 visual experience with siblings may also alter facial judgements (Luo, Kendrick, Li, & Lee, 2015;
160 Saxton, Little, DeBruine, Jones, & Roberts, 2009), and exposure to faces of a particular age
161 group enhances judgements made about faces in that age group (de Heering & Rossion, 2008).
162 Therefore, we also investigated the impact of visual exposure to babies on cuteness
163 judgements. Finally, given that a relationship between menopause and infant cuteness

164 judgements has been reported (Sprenelmeyer et al., 2009), we investigated whether that effect
165 held in our dataset. We had access to two different infant facial image stimuli sets which were
166 created from differently aged infants (newborn, and young babies aged around six months), and
167 we elected to use both stimuli sets in the study, allowing us to carry out a simultaneous
168 conceptual replication.

169

170

171 **2 Methods**

172

173 2.1 Participants

174

175 Participants consisted of 65 children (7 aged 7, 34 aged 8, 24 aged 9; 34 boys, 31 girls), and
176 330 adults (aged 18 – 66, mean 31.6, SD 13.9; 290 women, 41 men). 56 additional adults
177 accessed the online survey but did not complete it, and one adult participant did not give their
178 gender as male or female, and so their data were discarded. Children were recruited from two
179 schools in northern England, while adults were recruited online, via networks based
180 predominantly in the north-east of England. Of our child participants, 14 had a sibling aged 0 –
181 2; of our adult participants, 80 reported a substantial caregiving role with respect to a baby or
182 babies. Following the categorisation in (Sprenelmeyer et al., 2009), we additionally coded a
183 group of women aged 45 – 51 (n = 30; at or below the average age of menopause in Britain as
184 reported in Sprenelmeyer et al., 2009), and a group of women aged 53 – 60 (n = 25; above the
185 average age of menopause).

186

187 2.2 Materials

188

189 *“Newborn” and “Young Baby” image stimulus sets*

190

191 The infant stimulus sets (see Figure 1) consisted of 5 male and 5 female pairs of newborn
192 faces, and 5 male and 5 female pairs of young baby faces. Within each pair, the images were
193 identical, except that one had been manipulated to be more cute, and one had been
194 manipulated to be less cute (see details below). The images were created using the computer
195 graphics program PsychoMorph (Tiddeman, Burt, & Perrett, 2001). All of the infants in the
196 photographs had their eyes open.

197

198 To create the “Newborn” image stimulus set, first, pictures of 71 female and 71 male newborn
199 infants (aged 3 – 5 days) were taken from websites of different maternity wards, and placed in
200 an online survey. 50 adults (mean age = 27.2 years) rated them for cuteness (minimum of 42
201 ratings per image). 20 male and 20 female images rated of intermediate cuteness were placed
202 into sex-matched groups of 4 images, and each group of 4 images was combined to make a
203 composite image, giving rise to 5 male and 5 female composite images. Then, each composite
204 image was manipulated +/- 25% of the difference between a high-cute or low-cute sex-matched
205 prototype. These high-cute and low-cute prototypes were created separately for female and
206 male faces, and each consisted of the 10 faces rated cutest and 10 faces rated least cute from
207 the original set of 71 male and 71 female newborn images.

208

209 The “Young Baby” image stimulus set was that used in Lobmaier et al. (2015; 2010). To create
210 these faces, first, photographs of 25 male and 25 female infants aged 6 – 8 months were
211 separated into sex-matched groups of 5 images, and each group of 5 images was combined to
212 make a composite image, giving rise to 5 male and 5 female composite images. Then, each
213 composite was manipulated +/- 25% of the difference between a high-cute or low-cute sex-
214 matched prototype. These high-cute and low-cute prototypes were composites of the 10 male /
215 female faces rated most and least cute by the 10 young adult women and 10 young adult men
216 who rated a batch of 58 photographs of infants aged 5 – 8 months.

217

218 *Female facial image stimulus set*

219

220 Female facial images (see Figure 1) were taken from an online database (DeBruine & Jones,
221 2017) that provided images of white female students (aged 17 – 19; mean age 18.4 years) from
222 a university in Ontario, Canada. From this dataset, we took pairs of images that were
223 manipulated +/-50% along a dimension that had been created in Webmorph
224 (<https://webmorph.org>) with reference to the differences between the typical facial features /
225 shape of men compared to women. Accordingly, each pair consisted of two images that were
226 identical except that one was more feminised and the other was more masculinised. The
227 images were ‘unmasked’: i.e. the hairstyles and upper part of the shoulders were visible. This
228 protocol has been used previously in numerous studies that examine people’s facial
229 preferences (Rhodes, 2006).

230

Click on the face which you think is cuter...



Click on the face which you think is cuter...



Click on the face which you think is more attractive...



232

233 Figure 1: Examples of image stimuli, as presented to participants, from the three stimuli sets:
234 newborn (top row; 'cuter' on right), young baby (middle row; 'cuter' on left) and woman (bottom
235 row; 'more feminine' on right). The women image stimuli are taken from an online database
236 (DeBruine & Jones, 2017) under a Creative Commons licence.

237

238

239 2.3 Procedure

240

241 Ethical approval for the study was granted by the institutional ethics committee. The study ran
242 online (qualtrics.com), and requested participant consent followed by some demographic details
243 (age, gender; child participants were asked for the number and age of brothers and sisters,
244 while adult participants were asked whether they had a substantial caregiving role with respect
245 to a baby or babies). Next, participants were presented with the 40 pairs of faces, as a two-
246 alternative forced choice preference test (see Figure 1). Within each pair, the faces were
247 identical, except for being high- vs low-cute versions of the same infant face, or feminised vs
248 masculinised versions of the same woman's face. For each pair, the presentation side (right or
249 left) was randomised. The 20 infant face pairs were presented in a separate block from the 20
250 female face pairs, and the blocks were presented in counterbalanced order between
251 participants. Copies of the adult and child surveys are available on the OSF
252 (<https://osf.io/6aqru/>).

253

254 *Child participants*

255

256 Children were recruited from two schools in northern England. In the first school, children took
257 study information sheets home to parents / caregivers, who provided written consent if they
258 wished their child to take part. In the second school, consent was obtained from the school
259 acting in loco parentis, with opt-out letters distributed to parents of children in Years 3 and 4. In
260 the first school, children went through the survey supported one-to-one by the researcher, who
261 sat behind them so as not to influence their answers. The researcher checked that the children
262 understood the words 'cute' and 'attractive'. The former word was readily understood, and the
263 second was glossed as 'prettier' where appropriate. In the second school, children participated
264 in groups of up to five children, working silently each at a separate computer, and supervised to
265 eliminate collusion or distraction. The researcher asked the children whether they understood

266 the words 'cute' and 'attractive'. No child reported difficulty, and the classroom teacher
267 confirmed that the children involved should have understood these words. The children were
268 instructed to fold their arms to signal completion of the study, so that no other participants were
269 disrupted or felt the need to rush their responses, and were asked not to discuss the study with
270 their peers once back in the classroom until all children had completed the task.

271

272 *Adult participants*

273

274 Adult participants were recruited through channels including social networks and social media
275 advertisements circulated around networks predominantly based in the north-east of England,
276 and a research participation portal for psychology students at a university in the north-east of
277 England. All participated online. Online studies are widely used, provide comparable results in
278 many settings to offline data collection methodologies, and typically benefit from larger sample
279 sizes, thereby offsetting any increased noise in the data (Birnbbaum, 2004; Epstein, Klinkenberg,
280 Wiley, & McKinley, 2001; Krantz & Dalal, 2000).

281

282 2.4 Analysis

283

284 Analyses were performed in R 3.6.3 (R Core Development, 2019). After presenting descriptive
285 statistics and binomial tests for the face pairs, our core analyses consisted of Hierarchical
286 Bayesian Regression Models where the stimulus chosen was modeled as a Bernoulli trial
287 (attractive or cute stimulus chosen or not), using the "BRMS" package in R (Bürkner, 2017). The
288 estimation of each model was based on four chains, each containing 4,000 iterations (2,000 for
289 a warm-up), using the defaults from BRMS. The models showed very good convergence based
290 on \hat{R} . The random effects structure had a random intercept associated with the participant. We
291 tested if a model with the variables of interest (gender of the participant; stimulus type; age
292 group [adults vs children]) performed better than the null model, based on WAIC (Vehtari,
293 Gelman, & Gabry, 2017). We also tested the effects of the variable relating to exposure to
294 young children (whether children had siblings aged 0 – 2; whether adults replied 'yes' to the
295 question asking if they had a substantial caregiving role with respect to a baby or babies), and
296 of the factor that distinguished women below and above the average age of menopause,
297 following the grouping of Sprengelmeyer et al. (2009). Differences of over 10 units in the
298 information criterion can be interpreted as conclusive support for one model over another
299 (Burnham & Anderson, 2002, 2004). We also performed some additional analyses and

300 robustness checks (e.g., including a random intercept for stimulus pair). These analyses are
301 reported in full on the OSF (<https://osf.io/6aqru/>).

302

303 **3 Results**

304

305 3.1 Entire sample

306

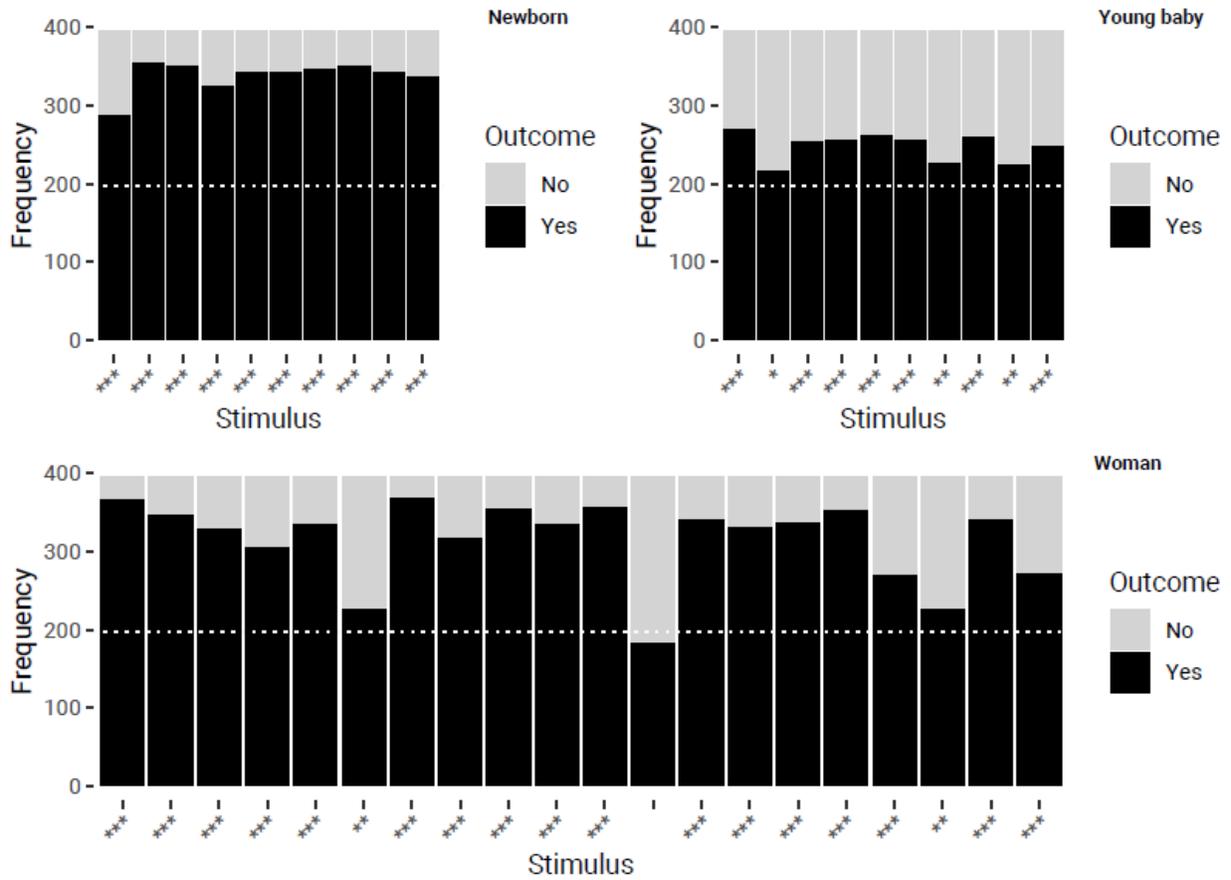
307 Binomial tests showed that participants' choices differed significantly from chance in 39 out of
308 40 stimulus pairs ($p < .05$ after correction with the Benjamini-Hochberg procedure; Benjamini &
309 Hochberg, 1995; Figure 2). Thus, with the exception of one stimulus in the adult woman
310 category (where participants were non-significantly more likely to select the masculinised face
311 as more attractive), participants were significantly more likely than chance to select the
312 feminised woman's face and the cuter newborn or young baby face. Performance was poorer
313 for the young baby stimuli than for the newborn or woman stimuli.

314

315 We calculated a null model (intercept only, WAIC = 15300.0) and a model of the form Gender +
316 Stimulus * Age group (main effect + two-way interaction, WAIC = 15285.3). These were both
317 out-performed by the best fitting model, which contained a three-way interaction, Stimulus *
318 Gender * Age group (WAIC = 15275.3). This three-way interaction suggests that gender
319 interacts with stimulus type differently in children compared to adults (Figure 3). Although adults
320 selected the expected stimulus as cuter / more attractive more often than children did overall,
321 this difference was not apparent in the males' judgements of the young baby stimuli. In contrast,
322 when it came to judgements of the newborn and women stimuli, there was a bigger difference
323 between male adult and child judgments than between female adult and child judgments. In
324 order to explore the three-way interaction further, we next examined the age groups (children vs
325 adults) separately.

326

327



328

329

330 Figure 2: Frequency with which the feminised woman or cuter newborn / young baby was
 331 chosen (Outcome = 'Yes') by the 395 participants (dashed line represents 197.5 participants), *
 332 $p < .05$, ** $p < .01$, *** $p < .001$ (Benjamini-Hochberg corrected).

333

334



335

336

337 Figure 3: Interaction between participant gender, age group (child vs adult), and stimulus type,
 338 in relation to the proportion of stimuli selected as cuter (newborn or young baby stimuli) or more
 339 attractive (woman stimuli). 0.5 = chance levels; error bars are 95% CIs.

340

341

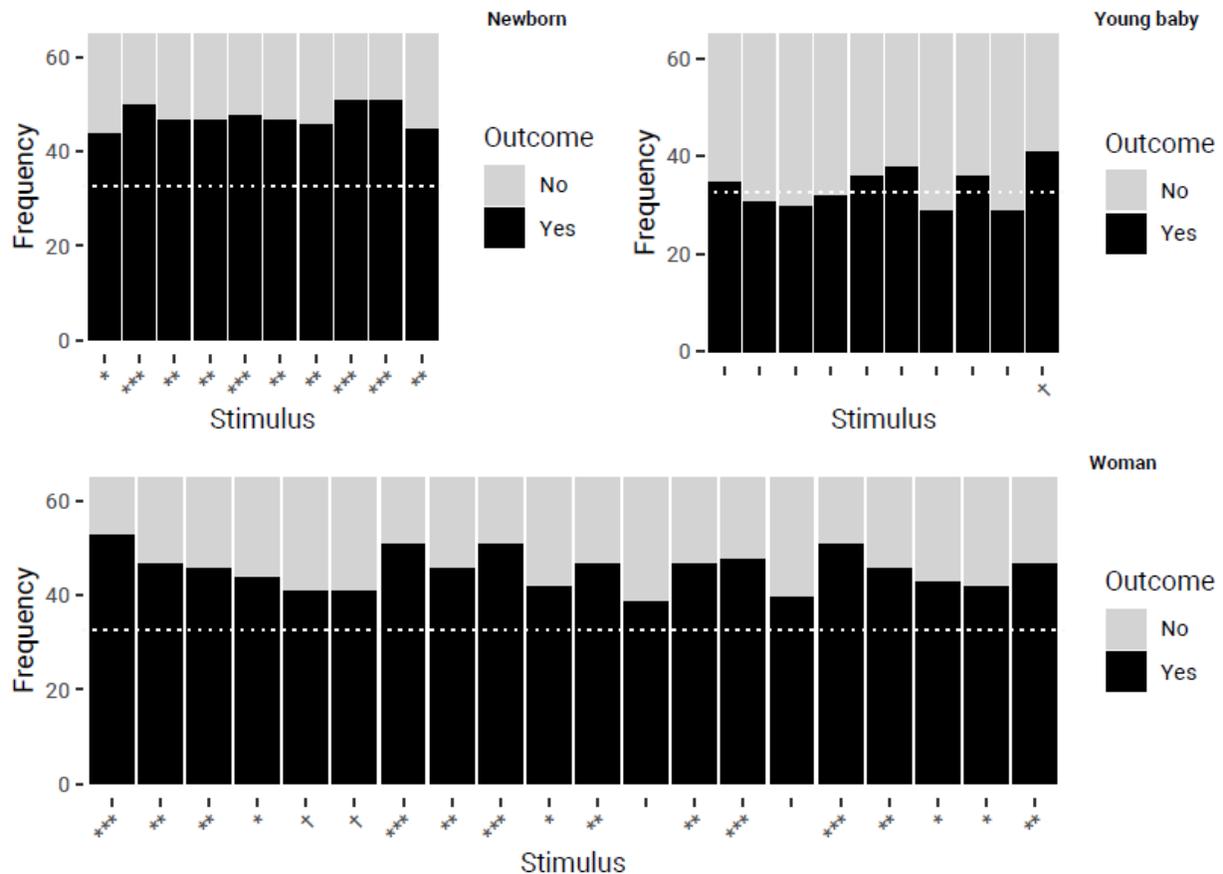
342 3.2 Children

343

344 In 26 of the 40 forced choice pairs, children chose in the expected direction (more feminine
 345 woman, cuter newborn) at rates significantly exceeding chance (at $p < .05$ after correction with
 346 the Benjamini-Hochberg procedure; Benjamini & Hochberg, 1995). However, children did not
 347 discriminate the set of young baby stimuli based on cuteness (Figure 3).

348

349



350

351

352 Figure 4: Frequency with which the feminised woman or cuter newborn / young baby was
 353 chosen (Outcome = 'Yes') by the 65 child participants (dashed line represents 32.5
 354 participants), † .05 < p < .10, * p < .05, ** p < .01, *** p < .001 (Benjamini-Hochberg corrected)

355

356

357 The best fitting model of the children's data contained an interaction between participant gender
 358 and stimulus (WAIC = 3185.2; Figure 3). Girls performed better than boys when assessing the
 359 newborn and woman stimuli. However, there was no gender difference in performance when
 360 judging the cuteness of the young baby stimuli, where performance was lower. This interaction
 361 model performed substantially better than a null model (WAIC = 3272.9), but only marginally
 362 better than a model with two main effects, one for gender and one for stimulus (WAIC =
 363 3186.5).

364

365 There was no suggestion of a difference in performance based on exposure to young children,
 366 namely, whether children had siblings aged 0 – 2 or not (WAIC = 3188.1 for a model of Stimulus

367 * Exposure + Gender). If anything, exposure was associated with poorer performance (see
 368 OSF, <https://osf.io/6aqrU/>), although only 14 of the 65 children fell into this group of children with
 369 much younger siblings.

370

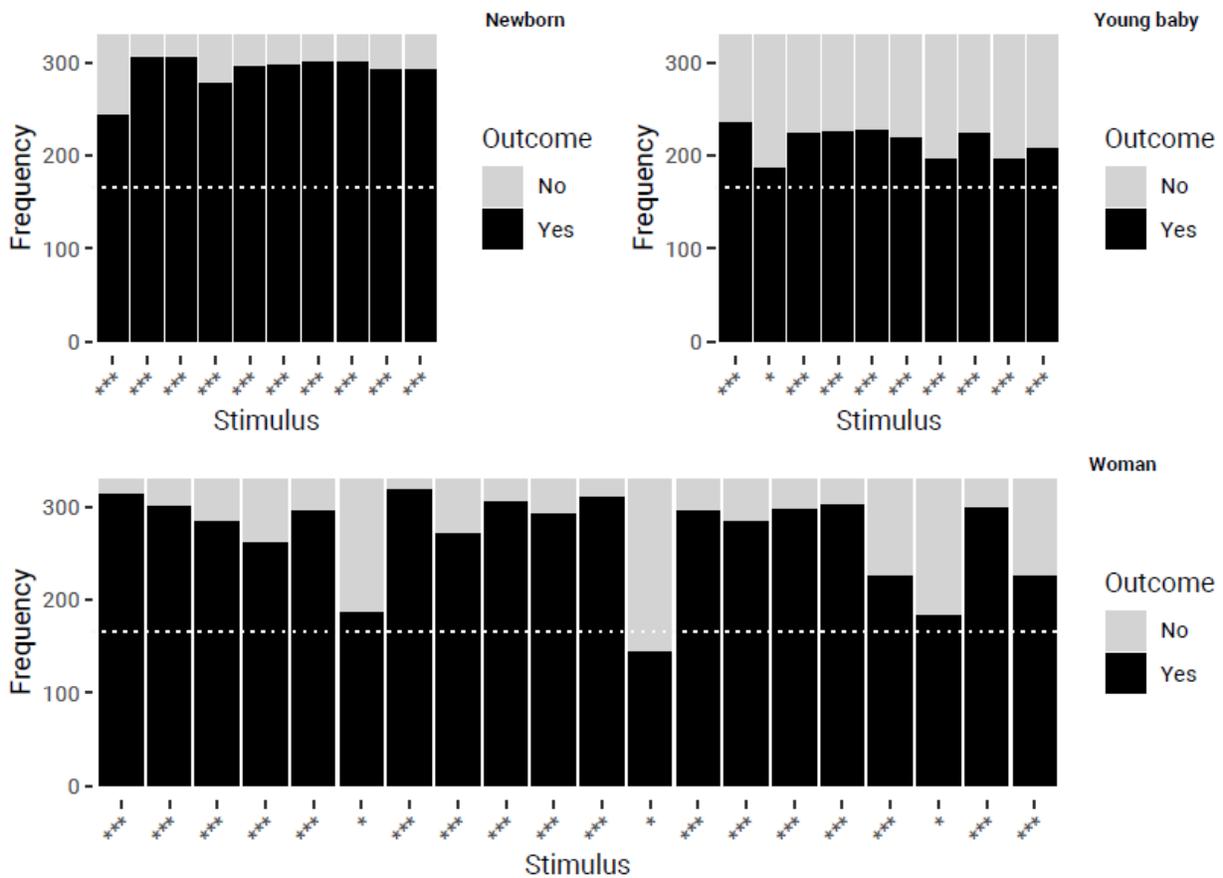
371 3.3 Adults

372

373 In 39 of 40 forced choice pairs, adults chose in the expected direction (more feminine woman,
 374 cuter newborn or young baby) at rates significantly exceeding chance (at $p < .05$ after correction
 375 with the Benjamini-Hochberg procedure; Benjamini & Hochberg, 1995). Unexpectedly, adults
 376 selected the masculinised version significantly more over than the feminised version in respect
 377 of one pair of women's faces. Overall, the adults' performance was substantially lower in
 378 relation to young baby stimuli than newborn or woman stimuli (Figures 3 and 5).

379

380



381

382

383 Figure 5: Frequency with which the feminised woman or cuter newborn / young baby was
384 chosen (Outcome = 'Yes') by the 330 adult participants (dashed line represents 165
385 participants), * $p < .05$, *** $p < .001$ (Benjamini-Hochberg corrected).
386

387

388

388 In relation to the adult dataset, a model with a Gender * Stimulus interaction (WAIC = 12081.0)
389 proved a better fit than a null model (WAIC = 12731.1) or a model with just a Gender and
390 Stimulus main effect (WAIC = 12091.5). While there was not much difference between men and
391 women in their judgments of newborn and women stimuli, men performed more poorly than
392 women when judging the young baby stimuli (Figure 3).
393

394

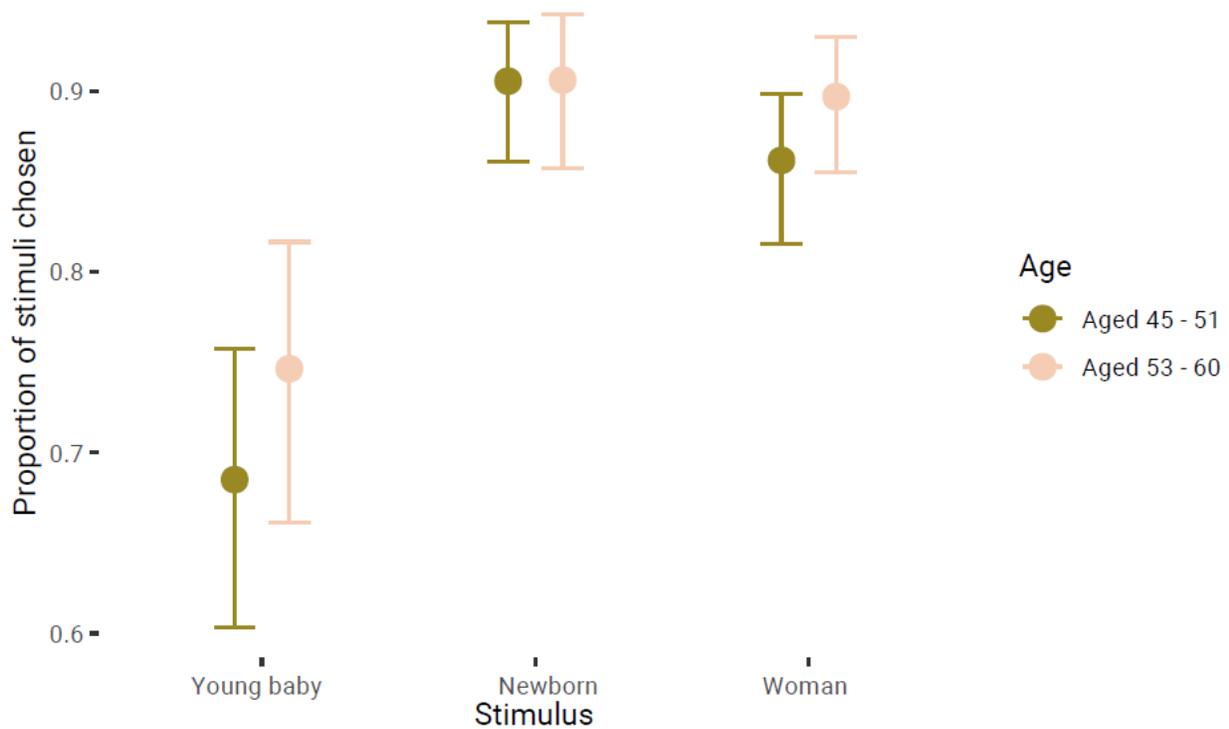
394 There was little support for a model that additionally accounted for participants' answers to the
395 question of whether they had a substantial caregiving role with respect to a baby or babies
396 (Stimulus * Child care + Gender: WAIC = 12088.8).
397

398

398 Among women, there was no support for the hypothesised difference between the purported
399 pre- and post-menopausal groups (women aged 45 – 51 vs women aged 53 – 60). The
400 interaction model with an Age category * Stimulus interaction (WAIC = 1875.3; Figure 6)
401 performed more poorly than a null model (WAIC = 1872.5).
402

403

404



404

405

406 Figure 6: Interaction between stimulus type and purported pre- and post-menopausal age group
 407 (women aged 45 - 51 vs aged 53 - 60), in relation to the proportion of stimuli selected as cuter
 408 (newborn or young baby stimuli) or more attractive (woman stimuli). 0.5 = chance levels; error
 409 bars are 95% CIs.

410

411

412 **4 Discussion**

413

414 We set out to uncover whether children aged 7 – 9 were responsive to subtle facial cues of baby
 415 cuteness, and how their judgements compared to adults' judgements. Further, we examined the
 416 impact of participant gender and exposure to infants, and carried out an analysis of purported
 417 pre- vs post-menopausal status in older women following a previous study (Sprengelmeyer et
 418 al., 2009). We used judgements of the attractiveness of feminised female faces as a control
 419 task, given that adult preferences for feminised female faces have been robustly demonstrated
 420 (Rhodes, 2006; Thornhill & Gangestad, 1999), whereas the extant research indicated that
 421 children in this age group do not draw substantially from cues of femininity / masculinity in rating
 422 facial attractiveness (Boothroyd et al., 2014).

423

424 Both boys and girls selected the cuter of the newborn images at rates exceeding chance. By
425 demonstrating children's awareness of even subtle cues, we have provided further evidence of
426 the impact of infant facial cuteness features. Baby cuteness has been framed as a trigger for
427 parental care, but this care may be supplied by people other than the parents (Kringelbach et
428 al., 2016; Schaller, 2018), including indeed other children. Children's reactions to baby cuteness
429 may support them in this endeavour. Having said this, children's performance on the baby
430 cuteness task was lower than adults'. We would expect lower task performance by prepubertal
431 children than adults on any cognitive task such as this, although this does also imply that adults
432 perform better than children do in discriminating infant cuteness. The difference between adults
433 and children was not apparent in relation to males' judgements of the young baby stimuli,
434 although this comparison relied on a smaller sample because of the smaller number of men who
435 took part.

436

437 We found that children discriminated cuteness reliably in our set of 'newborn' stimuli, but not in
438 our set of 'young baby' stimuli. This difference between the stimuli sets mirrored adult
439 judgements: adults more readily selected the cuter image from among the newborn than the
440 young baby stimulus sets. The newborn and young baby stimuli sets were created in similar
441 ways, but drew from different image pools, and evidently varied in the ease with which
442 participants could distinguish the relevant cues, indicating that the stimulus properties were not
443 equal between the stimulus groups. This could have arisen if there were a greater difference in
444 perceived cuteness between the cutest and least cute newborns than between the cutest and
445 least cute young babies in our dataset. Newborns are more dependent upon their mother than
446 weanlings (i.e. the 'young babies'), and so newborns may gain less than older infants do from
447 appealing to a wider range of potential caregivers. Studies have reported that infants are rated
448 cuter at the age of three or six months, compared to both newborn (Franklin, Volk, & Wong,
449 2018) and to older babies (Sanefuji et al., 2007), although other work found that 9 – 11-month-
450 olds were rated cuter than infants at younger or slightly older ages (excluding neonates)
451 (Hildebrandt & Fitzgerald, 1979a). Our study was not designed to compare the cuteness of
452 differently aged infants, and our results are perhaps a reminder of the importance of using a
453 range of stimuli in research studies given that different stimuli can give rise to differing results
454 (e.g. Hurlbert, 1984; Kroodsmas, Byers, Goodale, Johnson, & Liu, 2001; Wells & Windschitl,
455 1999); indeed, in our stimulus set consisting of women's faces, one stimulus pair was
456 unexpectedly judged more attractive in masculinised rather than feminised format.

457

458 It has been suggested that being able to distinguish cuter and less cute babies may provide the
459 adaptive benefit of allowing people to direct their caretaking resources towards those infants
460 who require lower levels of investment while having better chances of providing higher levels of
461 returns, perhaps particularly when resources are scarce (DeBruine, Hahn, & Jones, 2016;
462 Franklin et al., 2018; Hahn & Perrett, 2014). Consistent with this position, healthier-looking
463 infants are rated as cuter (Volk, Lukjanczuk, & Quinsey, 2005; Volk & Quinsey, 2002; Waller,
464 Volk, & Quinsey, 2004), and cuter babies receive greater visual attention (Hildebrandt &
465 Fitzgerald, 1978, 1981), and give rise to greater reports of caretaking motivation (Glocker et al.,
466 2009). Similarly, more attractive babies receive more affectionate and playful maternal
467 interactions (Hildebrandt & Fitzgerald, 1983; Langlois, Ritter, Casey, & Sawin, 1995). If the
468 ability to distinguish more or less cute babies is adaptive, our findings raise the possibility that
469 children too could personalise their caretaking investment in babies. On the other hand, perhaps
470 human abilities to distinguish subtle differences in infant cuteness are the application of an
471 ability whose function is to direct caretaking to infants, or perhaps to distinguish only the very
472 unhealthiest infants; it has been pointed out that the evaluation of fine-grained differences in
473 facial qualities may be evolutionarily novel (Penton-Voak, 2011). Contemporary culture provides
474 an intense training ground for distinguishing slight differences between faces, and this gives rise
475 to evaluative distinctions that might not have been part of our evolutionary history (Scott et al.,
476 2014). Further, it is not always the case that investing in the most healthy infants will provide the
477 most payback, given the law of diminishing returns, and dependent upon the resources
478 available to the investors. Investing additional care in healthy babies may make limited
479 differences to their outcomes, whereas greater returns may arise from investing in less healthy
480 babies. Finally, subtle differences in facial cues are probably less important than many other
481 variables such as kinship and infant temperament (DeBruine et al., 2016; Parsons et al., 2014),
482 or – especially when it comes to sibling caretaking – explicit adult instruction, all of which might
483 influence people to invest more or less in an infant. Given all of the above, we think that the
484 case for an adaptive ability to distinguish between marginally more or less cute infants is far
485 from closed; our findings indicate that children are alert to cues to infant cuteness, but do not
486 necessarily imply that distinguishing between subtly higher and lower levels of cuteness is itself
487 an adaptation.

488

489 We anticipate that our findings that 7 – 9 year-olds are alert to facial cues to cuteness in some
490 contexts would be applicable at least to all children who have some visual experience with baby

491 facial features (through exposure to babies or 'cute' toys etc). However, the frequency of
492 exposure to such a wide range of different faces that is characteristic of many media-immersed,
493 city-focused cultures (such as that where the study took place) has been argued to train
494 humans in face perception, leading them to respond to minute facial differences in evolutionarily
495 novel ways (Scott et al., 2014), and this makes it particularly important to determine whether our
496 findings are generalisable to other cultures. Having said that, the prevalence of sibling
497 caretaking across societies, and also in related species (e.g. Fairbanks, 1990), implies that
498 children's positive reactions to infantile features might be universal.

499

500 We did not find that children's exposure to younger siblings, or adults' exposure to infants, was
501 associated with enhanced judgements of baby cuteness, although only small numbers of
502 children fell into this group of participants with such exposure. However, even outside of sibling-
503 caretaking societies, the tending of dolls (or other representations of animate beings such as
504 bears) is a typical activity from early childhood, especially among girls (e.g. Cherney &
505 Dempsey, 2010; Lowe, 1975), and all of our participants would have had frequent exposure to
506 objects designed (increasingly over time) to be cute (Gould, 1992; Hinde & Barden, 1985),
507 including through films, toys, books, etc. Such saturation can create ceiling effects, perhaps
508 overwhelming any individual differences in cuteness perception contingent upon exposure.

509

510 Female participants had some performance advantages over male participants. Specifically,
511 women outperformed men in assessing the young baby (but not newborn or women) stimuli,
512 and girls outperformed boys when assessing the newborn and women (but not young baby)
513 stimuli. This is consistent with much previous research. For example, a cross-sectional study of
514 children in different classes (from 2nd grade, around 7 – 8 years of age, to 12th grade, around
515 17 – 18 years of age), and adults, found that girls shifted from preferring adult faces to
516 preferring infant faces by about 8th grade (around 13 – 14 years of age), whereas boys'
517 preferences for infants over adults only exceeded chance from around 12th grade (Fullard &
518 Reiling, 1976). Overall, women appear to be more sensitive than men to subtle differences in
519 infant facial cuteness (Lobmaier et al., 2010; Sprengelmeyer et al., 2009). There are many
520 similar documented gender differences in reactions to infants (Berman, 1980; Hahn & Perrett,
521 2014; Scherf, 2012), although differences in women's and men's reactions to infants overlap to
522 greater or lesser extents depending on setting, and sit alongside extensive individual
523 differences. This pattern of differences between men and women no doubt represents a whole

524 range of different mechanisms, including neural, hormonal, and social (Berman, 1980; Hahn &
525 Perrett, 2014; Scherf, 2012).

526

527 We did not anticipate that our child participants would select the feminised female faces as
528 more attractive, because previous research (albeit with a smaller number of feminised face
529 stimuli) had indicated that explicit preferences for facial femininity are not apparent at age 9
530 (Boothroyd et al., 2014), but then have emerged by age 11 (Saxton, DeBruine, et al., 2009); see
531 also (Saxton et al., 2010). However, we found that both boys and girls aged 7 – 9 selected the
532 feminised women’s faces as more attractive than the masculinised women’s faces, in line with
533 adult judgements (although not as reliably as the adults). Indeed, it has been shown previously
534 that even children younger than our participants distinguish feminised and masculinised faces.
535 By 4 years of age, children were robustly selecting dominant men’s faces as being stronger or in
536 charge (Terrizzi, Brey, Shutts, & Beier, 2019), and infants aged 12 – 24 months looked longer at
537 (i.e. demonstrated a visual preference for) feminised over masculinised male and female faces.
538 Future research would be needed to continue to tease out the origins of explicit preferences for
539 facial femininity, as well as variables such as visual experience (Boothroyd et al., 2016; Saxton,
540 Little, et al., 2009) that might predict the early emergence of these preferences.

541

542 We failed to replicate previous findings (Sprengelmeyer et al., 2009) that women aged 45 – 51
543 (i.e. at or younger than the average age of menopause in Britain cited by Sprengelmeyer et al.,
544 2009) outperformed women aged 53 – 60 (above the average age of menopause) in judging
545 infant cuteness. Our sample size ($n = 55$) was more than double than that of the original study
546 ($n = 24$), although unlike the original study, we did not confirm that no participant was taking
547 hormone-replacement therapy or had undergone hysterectomy. Future work could scrutinise
548 this question further, by using larger samples again, and confirming menopausal status (as in
549 the second study of Sprengelmeyer et al., 2009). However, in the same way that we would
550 argue that children’s discrimination of infant cuteness could have functional significance given
551 that children provide a reasonable proportion of childcare the world over (Weisner, 1987;
552 Weisner et al., 1977), we also know that post-menopausal women provide significant
553 proportions of childcare globally (Coall & Hertwig, 2010; Fergusson, Maughan, & Golding, 2008;
554 Jappens & Van Bavel, 2012), and thus might also benefit from distinguishing infant cuteness.

555

556 Despite our novel findings, the study has some limitations. Baby cuteness was manipulated
557 merely with reference to rated cuteness, rather than being pinned to any behavioural or

558 biological corollary (such as the likelihood of eliciting care, or infant health), and as such, we
559 cannot conclude that adults demonstrated objectively superior performance. Our methodological
560 choice here followed other work in relation to perceptions of infant facial cuteness (Lobmaier et
561 al., 2015; Sprengelmeyer et al., 2013; Sprengelmeyer et al., 2009), and was well-suited to allow
562 us to compare adult and child perceptions. The stimuli were clearly computer generated rather
563 than actual photographs, which could have impeded performance, perhaps particularly in the
564 child rather than the adult group, although it did not impede performance sufficiently to obscure
565 the children's preferences; the advantage of computer generated images is that they allow us to
566 manipulate just the variable of interest. Future work might explore cuteness perceptions in other
567 domains, including using implicit measures (Hahn, Xiao, Sprengelmeyer, & Perrett, 2013;
568 Parsons, Young, Kumari, Stein, & Kringelbach, 2011).

569
570 In conclusion, we found that both boys and girls aged 7 – 9 could distinguish subtle cues to
571 infant cuteness, and this ability to detect facial cues to cuteness was not diminished in a group
572 of purportedly post-menopausal women. This is consistent with reports that children aged 7 or
573 younger, as well as grandparents, provide notable portions of infant caretaking globally
574 (Weisner, 1987; Weisner et al., 1977); the functional explanations given of adults' reactions to
575 cuteness, that it directs appropriate caregiving behaviour, could also apply to this extended age
576 group of potential caregivers.

577

578

579 **5 References**

580

581 Alley, T. R. (1981). Head shape and the perception of cuteness. *Developmental Psychology*,
582 17(5), 650-654. doi:10.1037/0012-1649.17.5.650

583 Archer, J. (2019). The reality and evolutionary significance of human psychological sex
584 differences. *Biological Reviews*, 94(4), 1381-1415. doi:10.1111/brv.12507

585 Benjamini, Y., & Hochberg, Y. (1995). Controlling the false discovery rate: A practical and
586 powerful approach to multiple testing. *Journal of the Royal Statistical Society. Series B*
587 (*Methodological*), 57(1), 289-300. doi:10.2307/2346101

588 Berman, P. W. (1980). Are women more responsive than men to the young? A review of
589 developmental and situational variables. *Psychological Bulletin*, 88(3), 668-695.

590 doi:10.1037/0033-2909.88.3.668

591 Birnbaum, M. H. (2004). Human research and data collection via the internet. *Annual Review of*
592 *Psychology*, 55(1), 803-832. doi:10.1146/annurev.psych.55.090902.141601

593 Boothroyd, L. G., Jucker, J.-L., Thornborrow, T., Jamieson, M. A., Burt, D. M., Barton, R. A., . . .
594 Tovee, M. J. (2016). Television exposure predicts body size ideals in rural Nicaragua.
595 *British Journal of Psychology*, 107(4), 752-767. doi:10.1111/bjop.12184

596 Boothroyd, L. G., Meins, E., Vukovic, J., & Burt, D. M. (2014). Developmental changes in
597 children's facial preferences. *Evolution and Human Behavior*, 35(5), 376-383.
598 doi:10.1016/j.evolhumbehav.2014.05.002

599 Borgi, M., & Cirulli, F. (2013). Children's preferences for infantile features in dogs and cats.
600 *Human-Animal Interaction Bulletin*, 1(2), 1-15.

601 Borgi, M., Cogliati-Dezza, I., Brelsford, V., Meints, K., & Cirulli, F. (2014). Baby schema in
602 human and animal faces induces cuteness perception and gaze allocation in children.
603 *Frontiers in Psychology*, 5(411). doi:10.3389/fpsyg.2014.00411

604 Brosch, T., Sander, D., & Scherer, K. R. (2007). That baby caught my eye... Attention capture
605 by infant faces. *Emotion*, 7(3), 685-689. doi:10.1037/1528-3542.7.3.685

606 Bürkner, P.-C. (2017). brms: An R Package for Bayesian Multilevel Models Using Stan. 2017,
607 80(1), 28. doi:10.18637/jss.v080.i01

608 Burnham, K. P., & Anderson, D. R. (2002). *Model selection and multi-model inference: A*
609 *practical information-theoretic approach*. New York: Springer.

610 Burnham, K. P., & Anderson, D. R. (2004). Understanding AIC and BIC in model selection.
611 *Sociological Methods and Research*, 33(2), 261-304. doi:10.1177/0049124104268644

612 Cherney, I. D., & Dempsey, J. (2010). Young children's classification, stereotyping and play
613 behaviour for gender neutral and ambiguous toys. *Educational Psychology*, 30(6), 651-
614 669. doi:10.1080/01443410.2010.498416

615 Coall, D. A., & Hertwig, R. (2010). Grandparental investment: Past, present, and future.
616 *Behavioral and Brain Sciences*, 33(1), 1-19. doi:10.1017/S0140525X09991105

617 Dale, J. P., Goggin, J., Leyda, J., McIntyre, A. P., & Negra, D. (2016). *The Aesthetics and*
618 *Affects of Cuteness* (1st ed.). New York: Routledge.

619 de Heering, A., & Rossion, B. (2008). Prolonged visual experience in adulthood modulates
620 holistic face perception. *PLoS ONE*, 3(5), e2317. doi:10.1371/journal.pone.0002317

621 DeBruine, L. M., Hahn, A. C., & Jones, B. C. (2016). Perceiving infant faces. *Current Opinion in*
622 *Psychology*, 7, 87-91. doi:10.1016/j.copsyc.2015.08.010

623 DeBruine, L. M., & Jones, B. C. (2017). Young adult white faces with manipulated versions.
624 Retrieved from

625 https://figshare.com/articles/Young_Adult_White_Faces_with_Manipulated_Versions/42
626 [20517](#)

627 Epstein, J., Klinkenberg, W. D., Wiley, D., & McKinley, L. (2001). Insuring sample equivalence
628 across internet and paper-and-pencil assessments. *Computers in Human Behavior*,
629 17(3), 339-346. doi:10.1016/S0747-5632(01)00002-4

630 Esposito, G., Nakazawa, J., Ogawa, S., Stival, R., Kawashima, A., Putnick, D. L., & Bornstein,
631 M. H. (2014). Baby, you light-up my face: Culture-general physiological responses to
632 infants and culture-specific cognitive judgements of adults. *PLoS ONE*, 9(10), e106705.
633 doi:10.1371/journal.pone.0106705

634 Fairbanks, L. A. (1990). Reciprocal benefits of allomothering for female vervet monkeys. *Animal*
635 *Behaviour*, 40(3), 553-562. doi:10.1016/S0003-3472(05)80536-6

636 Fergusson, E., Maughan, B., & Golding, J. (2008). Which children receive grandparental care
637 and what effect does it have? *Journal of Child Psychology and Psychiatry*, 49(2), 161-
638 169. doi:10.1111/j.1469-7610.2007.01840.x

639 Franklin, P., Volk, A. A., & Wong, I. (2018). Are newborns' faces less appealing? *Evolution and*
640 *Human Behavior*, 39(3), 269-276. doi:10.1016/j.evolhumbehav.2018.01.003

641 Frodi, A. M., Murray, A. D., Lamb, M. E., & Steinberg, J. (1984). Biological and social
642 determinants of responsiveness to infants in 10-to-15-year-old girls. *Sex Roles*, 10(7),
643 639-649. doi:10.1007/BF00287271

644 Fullard, W., & Reiling, A. M. (1976). An investigation of Lorenz's "babyiness". *Child*
645 *Development*, 47(4), 1191-1193. doi:10.2307/1128462

646 Glocker, M. L., Langleben, D. D., Ruparel, K., Loughhead, J. W., Gur, R. C., & Sachser, N.
647 (2009). Baby schema in infant faces induces cuteness perception and motivation for
648 caretaking in adults. *Ethology*, 115(3), 257-263. doi:10.1111/j.1439-0310.2008.01603.x

649 Goldberg, S., Blumberg, S. L., & Kriger, A. (1982). Menarche and interest in infants: Biological
650 and social influences. *Child Development*, 53(6), 1544-1550. doi:10.2307/1130082

651 Golle, J., Probst, F., Mast, F. W., & Lobmaier, J. S. (2015). Preference for cute infants does not
652 depend on their ethnicity or species: Evidence from hypothetical adoption and donation
653 paradigms. *PLoS ONE*, 10(4), e0121554. doi:10.1371/journal.pone.0121554

654 Gould, S. J. (1992). *The Panda's Thumb: More Reflections in Natural History*. New York: WW
655 Norton & Company.

656 Hahn, A. C., DeBruine, L. M., Fisher, C. I., & Jones, B. C. (2015). The reward value of infant
657 facial cuteness tracks within-subject changes in women's salivary testosterone.
658 *Hormones and Behavior*, 67, 54-59. doi:10.1016/j.yhbeh.2014.11.010

659 Hahn, A. C., & Perrett, D. I. (2014). Neural and behavioral responses to attractiveness in adult
660 and infant faces. *Neuroscience and Biobehavioral Reviews*, 46, 591-603.
661 doi:10.1016/j.neubiorev.2014.08.015

662 Hahn, A. C., Xiao, D., Sprengelmeyer, R., & Perrett, D. I. (2013). Gender differences in the
663 incentive salience of adult and infant faces. *Quarterly Journal of Experimental*
664 *Psychology*, 66(1), 200-208. doi:10.1080/17470218.2012.705860

665 Hewlett, B. S., & Lamb, M. E. (Eds.). (2017). *Hunter-gatherer childhoods: Evolutionary,*
666 *developmental, and cultural perspectives*. London: Routledge.

667 Hildebrandt, K. A., & Fitzgerald, H. E. (1978). Adults' responses to infants varying in perceived
668 cuteness. *Behavioural Processes*, 3(2), 159-172. doi:10.1016/0376-6357(78)90042-6

669 Hildebrandt, K. A., & Fitzgerald, H. E. (1979a). Adults' perceptions of infant sex and cuteness.
670 *Sex Roles*, 5, 471-481. doi:10.1007/BF00287322

671 Hildebrandt, K. A., & Fitzgerald, H. E. (1979b). Facial feature determinants of perceived infant
672 attractiveness. *Infant Behavior and Development*, 2, 329-339. doi:10.1016/S0163-
673 6383(79)80043-0

674 Hildebrandt, K. A., & Fitzgerald, H. E. (1981). Mothers' responses to infant physical appearance.
675 *Infant Mental Health Journal*, 2(1), 56-61. doi:10.1002/1097-0355(198121)2:1<56::Aid-
676 imhj2280020109>3.0.Co;2-g

677 Hildebrandt, K. A., & Fitzgerald, H. E. (1983). The infant's physical attractiveness: Its effect on
678 bonding and attachment. *Infant Mental Health Journal*, 4(1), 3-12. doi:10.1002/1097-
679 0355(198321)4:1<1::AID-IMHJ2280040102>3.0.CO;2-2

680 Hinde, R. A., & Barden, L. A. (1985). The evolution of the teddy bear. *Animal Behaviour*, 33(4),
681 1371-1373. doi:10.1016/S0003-3472(85)80205-0

682 Hückstedt, B. (1965). Experimentelle Untersuchungen zum "Kindchenschema." [Experimental
683 investigations on the "Kindchenschema" (baby-schema).]. *Zeitschrift fur Experimentelle*
684 *und Angewandte Psychologie*, 12(3), 421-450.

685 Hurlbert, S. H. (1984). Pseudoreplication and the design of ecological field experiments.
686 *Ecological Monographs*, 54(2), 187-211. doi:10.2307/1942661

687 Jappens, M., & Van Bavel, J. (2012). Regional family norms and child care by grandparents in
688 Europe. *Demographic Research*, 27, 85-120. doi:10.4054/DemRes.2012.27.4

689 Krantz, J. H., & Dalal, R. (2000). Validity of Web-based psychological research. In *Psychological*
690 *experiments on the Internet*. (pp. 35-60). San Diego, CA, US: Academic Press.

691 Kringelbach, M. L., Stark, E. A., Alexander, C., Bornstein, M. H., & Stein, A. (2016). On
692 cuteness: Unlocking the parental brain and beyond. *Trends in Cognitive Sciences*, 20(7),
693 545–558. doi:10.1016/j.tics.2016.05.003

694 Kroodsma, D. E., Byers, B. E., Goodale, E., Johnson, S., & Liu, W.-C. (2001). Pseudoreplication
695 in playback experiments, revisited a decade later. *Animal Behaviour*, 61, 1029-1033.

696 Langlois, J. H., Ritter, J. M., Casey, R. J., & Sawin, D. B. (1995). Infant attractiveness predicts
697 maternal behaviors and attitudes. *Developmental Psychology*, 31(3), 464-472.
698 doi:10.1037/0012-1649.31.3.464

699 Lieberman, D., Tooby, J., & Cosmides, L. (2007). The architecture of human kin detection.
700 *Nature*, 445(7129), 727-731. doi:10.1038/nature05510

701 Little, A. C. (2012). Manipulation of infant-like traits affects perceived cuteness of infant, adult
702 and cat faces. *Ethology*, 118(8), 775-782. doi:10.1111/j.1439-0310.2012.02068.x

703 Lobmaier, J. S., Probst, F., Perrett, D. I., & Heinrichs, M. (2015). Menstrual cycle phase affects
704 discrimination of infant cuteness. *Hormones and Behavior*, 70, 1-6.
705 doi:10.1016/j.yhbeh.2015.02.001

706 Lobmaier, J. S., Sprengelmeyer, R., Wiffen, B., & Perrett, D., I. . (2010). Female and male
707 responses to cuteness, age and emotion in infant faces. *Evolution and Human Behavior*,
708 31(1), 16-21. doi:10.1016/j.evolhumbehav.2009.05.004

709 Lorenz, K. (1943). The innate forms of potential experience. *Zeitschrift fur Tierpsychologie*, 5,
710 234-409.

711 Lowe, M. (1975). Trends in the development of representational play in infants from one to three
712 years: An observational study. *Child Psychology & Psychiatry & Allied Disciplines*, 16(1),
713 33-47. doi:10.1111/j.1469-7610.1975.tb01870.x

714 Luo, L., Kendrick, K. M., Li, H., & Lee, K. (2015). Adults with siblings like children's faces more
715 than those without. *Journal of Experimental Child Psychology*, 129, 148-156.
716 doi:10.1016/j.jecp.2014.09.003

717 Luo, L., Ma, X., Zheng, X., Zhao, W., Xu, L., Becker, B., & Kendrick, K. (2015). Neural systems
718 and hormones mediating attraction to infant and child faces. *Frontiers in Psychology*,
719 6(970). doi:10.3389/fpsyg.2015.00970

720 Morris, P. H., Reddy, V., & Bunting, R. C. (1995). The survival of the cutest: who's responsible
721 for the evolution of the teddy bear? *Animal Behaviour*, 50(6), 1697-1700.
722 doi:10.1016/0003-3472(95)80022-0

723 Parsons, C. E., Young, K. S., Bhandari, R., van Ijzendoorn, M. H., Bakermans-Kranenburg, M.
724 J., Stein, A., & Kringelbach, M. L. (2014). The bonnie baby: experimentally manipulated

725 temperament affects perceived cuteness and motivation to view infant faces.
726 *Developmental Science*, 17(2), 257-269. doi:10.1111/desc.12112

727 Parsons, C. E., Young, K. S., Kumari, N., Stein, A., & Kringelbach, M. L. (2011). The
728 motivational salience of infant faces is similar for men and women. *PLoS ONE*, 6(5),
729 e20632. doi:10.1371/journal.pone.0020632

730 Penton-Voak, I. S. (2011). In retreat from nature? Successes and concerns in Darwinian
731 approaches to facial attractiveness. *Journal of Evolutionary Psychology*, 1-21.
732 doi:10.1556/JEP.9.2011.2.5

733 Proverbio, A. M., Riva, F., Zani, A., & Martin, E. (2011). Is it a baby? Perceived age affects brain
734 processing of faces differently in women and men. *Journal of Cognitive Neuroscience*,
735 23(11), 3197-3208. doi:10.1162/jocn_a_00041 %M 21557651

736 R Core Development, T. (2019). R: A language and environment for statistical computing.
737 Vienna, Austria: R Foundation for Statistical Computing. Retrieved from [http://www.R-](http://www.R-project.org/)
738 [project.org/](http://www.R-project.org/)

739 Rhodes, G. (2006). The evolutionary psychology of facial beauty. *Annual Review of Psychology*,
740 57, 199-226. doi:10.1146/annurev.psych.57.102904.190208

741 Sanefuji, W., Ohgami, H., & Hashiya, K. (2007). Development of preference for baby faces
742 across species in humans (*Homo sapiens*). *Journal of Ethology*, 25(3), 249-254.
743 doi:10.1007/s10164-006-0018-8

744 Saxton, T. K., Caryl, P. G., & Roberts, S. C. (2006). Vocal and facial attractiveness judgments of
745 children, adolescents and adults: the ontogeny of mate choice. *Ethology*, 112(12), 1179-
746 1185. doi:10.1111/j.1439-0310.2006.01278.x

747 Saxton, T. K., DeBruine, L. M., Jones, B. C., Little, A. C., & Roberts, S. C. (2009). Face and
748 voice attractiveness judgments change during adolescence. *Evolution and Human*
749 *Behavior*, 30(6), 398-408. doi:10.1016/j.evolhumbehav.2009.06.004

750 Saxton, T. K., Kohoutova, D., Roberts, S. C., Jones, B. C., DeBruine, L. M., & Havlicek, J.
751 (2010). Age, puberty and attractiveness judgments in adolescents. *Personality and*
752 *Individual Differences*, 49, 857-862. doi:10.1016/j.paid.2010.07.016

753 Saxton, T. K., Little, A. C., DeBruine, L. M., Jones, B. C., & Roberts, S. C. (2009). Adolescents'
754 preferences for sexual dimorphism are influenced by relative exposure to male and
755 female faces. *Personality and Individual Differences*, 47, 864-868.
756 doi:10.1016/j.paid.2009.07.005

757 Schaller, M. (2018). The parental care motivational system and why it matters (for everyone).
758 *Current Directions In Psychological Science*, 27(5), 295-301.
759 doi:10.1177/0963721418767873

760 Scherf, K. S., Berhmann, M., Dahl, R.E. (2012). Facing changes and changing faces in
761 adolescence: a new model for investigating adolescent-specific interactions between
762 pubertal, brain and behavioral development. *Developmental Cognitive Neuroscience*,
763 2(2), 199-219. doi:10.1016/j.dcn.2011.07.016

764 Scott, I. M. L., Clark, A. P., Josephson, S. C., Boyette, A. H., Cuthill, I. C., Fried, R. L., . . .
765 Penton-Voak, I. S. (2014). Human preferences for sexually dimorphic faces may be
766 evolutionarily novel. *Proceedings of the National Academy of Sciences*, 111(40), 14388-
767 14393. doi:10.1073/pnas.1409643111

768 Sprengelmeyer, R., Lewis, J., Hahn, A., & Perrett, D. I. (2013). Aesthetic and incentive salience
769 of cute infant faces: Studies of observer sex, oral contraception and menstrual cycle.
770 *PLoS ONE*, 8(5), e65844. doi:10.1371/journal.pone.0065844

771 Sprengelmeyer, R., Perrett, D. I., Fagan, E. C., Cornwell, R. E., Lobmaier, J. S.,
772 Sprengelmeyer, A., . . . Young, A. W. (2009). The cutest little baby face: A hormonal link
773 to sensitivity to cuteness in infant faces. *Psychological Science*, 20(2), 149-154.
774 doi:10.1111/j.1467-9280.2009.02272.x

775 Terrizzi, B. F., Brey, E., Shutts, K., & Beier, J. S. (2019). Children's developing judgments about
776 the physical manifestations of power. *Developmental Psychology*, 55(4), 793-808.
777 doi:10.1037/dev0000657

778 Thornhill, R., & Gangestad, S. W. (1999). Facial attractiveness. *Trends in Cognitive Sciences*,
779 3(12), 452. doi:10.1016/S1364-6613(99)01403-5

780 Tiddeman, B., Burt, D. M., & Perrett, D. (2001). Computer graphics in facial perception
781 research. *IEEE Computer Graphics and Applications*, 21(5), 42-50.
782 doi:10.1109/38.946630

783 Vehtari, A., Gelman, A., & Gabry, J. (2017). Practical Bayesian model evaluation using leave-
784 one-out cross-validation and WAIC. *Statistics and Computing*, 27(5), 1413-1432.
785 doi:10.1007/s11222-016-9696-4

786 Volk, A., Lukjanczuk, J. M., & Quinsey, V. L. (2005). Influence of infant and child facial cues of
787 low body weight on adults' ratings of adoption preference, cuteness, and health. *Infant*
788 *Mental Health Journal*, 26(5), 459-469. doi:10.1002/imhj.20064

789 Volk, A., & Quinsey, V. L. (2002). The influence of infant facial cues on adoption preferences.
790 *Human Nature*, 13(4), 437-455. doi:10.1007/s12110-002-1002-9

791 Waller, K. L., Volk, A., & Quinsey, V. L. (2004). The effect of infant fetal alcohol syndrome facial
792 features on adoption preference. *Human Nature*, 15(1), 101-117. doi:10.1007/s12110-
793 004-1006-8

794 Weisner, T. S. (1987). Socialization for parenthood in sibling caretaking societies. In J. B.
795 Lancaster, J. Altmann, A. S. Rossi, & L. R. Sherrod (Eds.), *Parenting Across the Life*
796 *Span: Biosocial Dimensions* (pp. 237–270). New York: Routledge.

797 Weisner, T. S., Gallimore, R., Bacon, M. K., Herbert Barry, I., Bell, C., Novaes, S. C., . . .
798 Williams, T. R. (1977). My brother's keeper: Child and sibling caretaking [and comments
799 and reply]. *Current Anthropology*, 18(2), 169-190. doi:10.1086/201883

800 Wells, G. L., & Windschitl, P. D. (1999). Stimulus sampling and social psychological
801 experimentation. *Personality and Social Psychology Bulletin*, 25(9), 1115-1125.
802 doi:10.1177/01461672992512005

803 Zebrowitz, L. A., & Montepare, J. M. (1992). Impressions of babyfaced individuals across the life
804 span. *Developmental Psychology*, 28(6), 1143-1152. doi:10.1037/0012-1649.28.6.1143
805