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

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Abstract

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

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

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

1 Introduction

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

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

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

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

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

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

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

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

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

2 Methods

2.1 Participants

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

2.2 Materials

"Newborn" and "Young Baby" image stimulus sets

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

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

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

Female facial image stimulus set

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

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...

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

2.3 Procedure

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

Child participants

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

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

Adult participants

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

2.4 Analysis

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

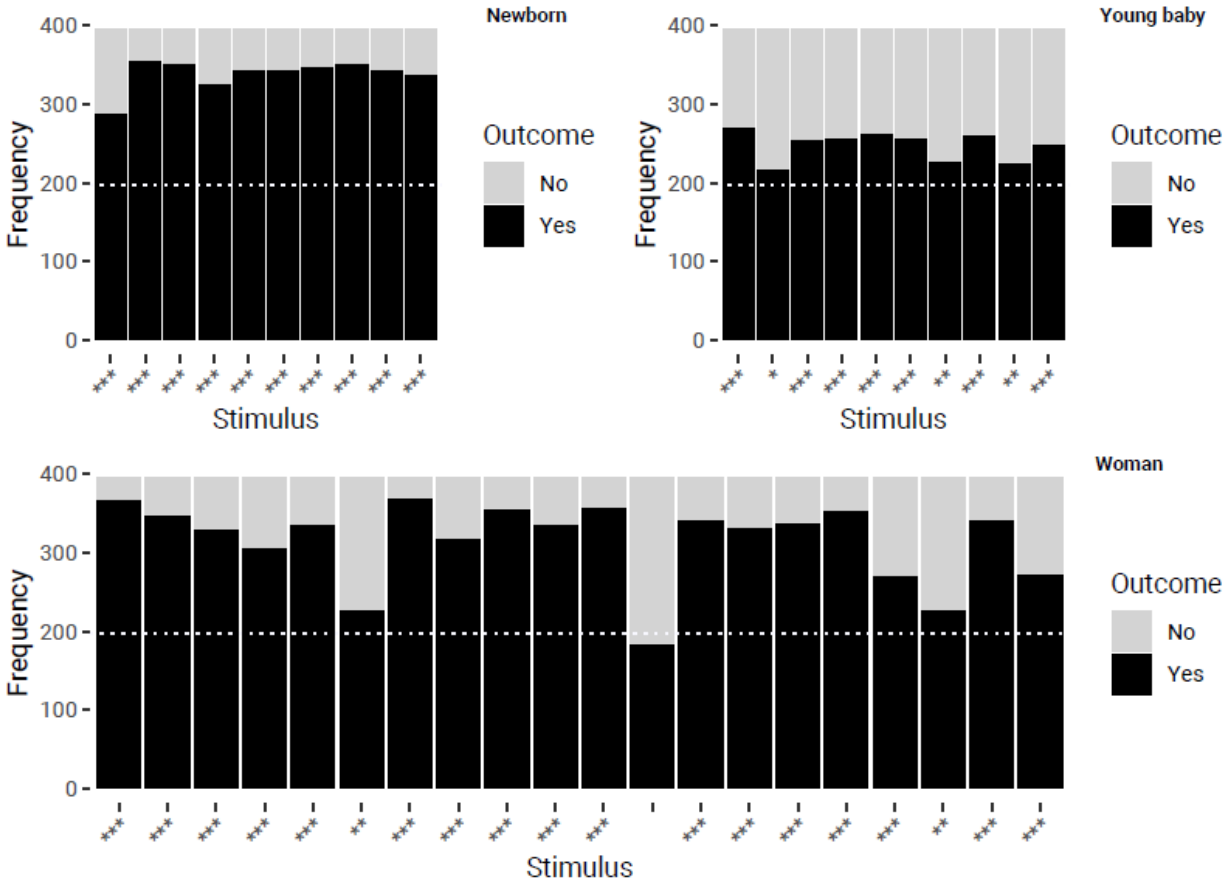
robustness checks (e.g., including a random intercept for stimulus pair). These analyses are reported in full on the OSF (https://osf.io/6aqru/).

3 Results

3.1 Entire sample

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

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



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

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

3.2 Children

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

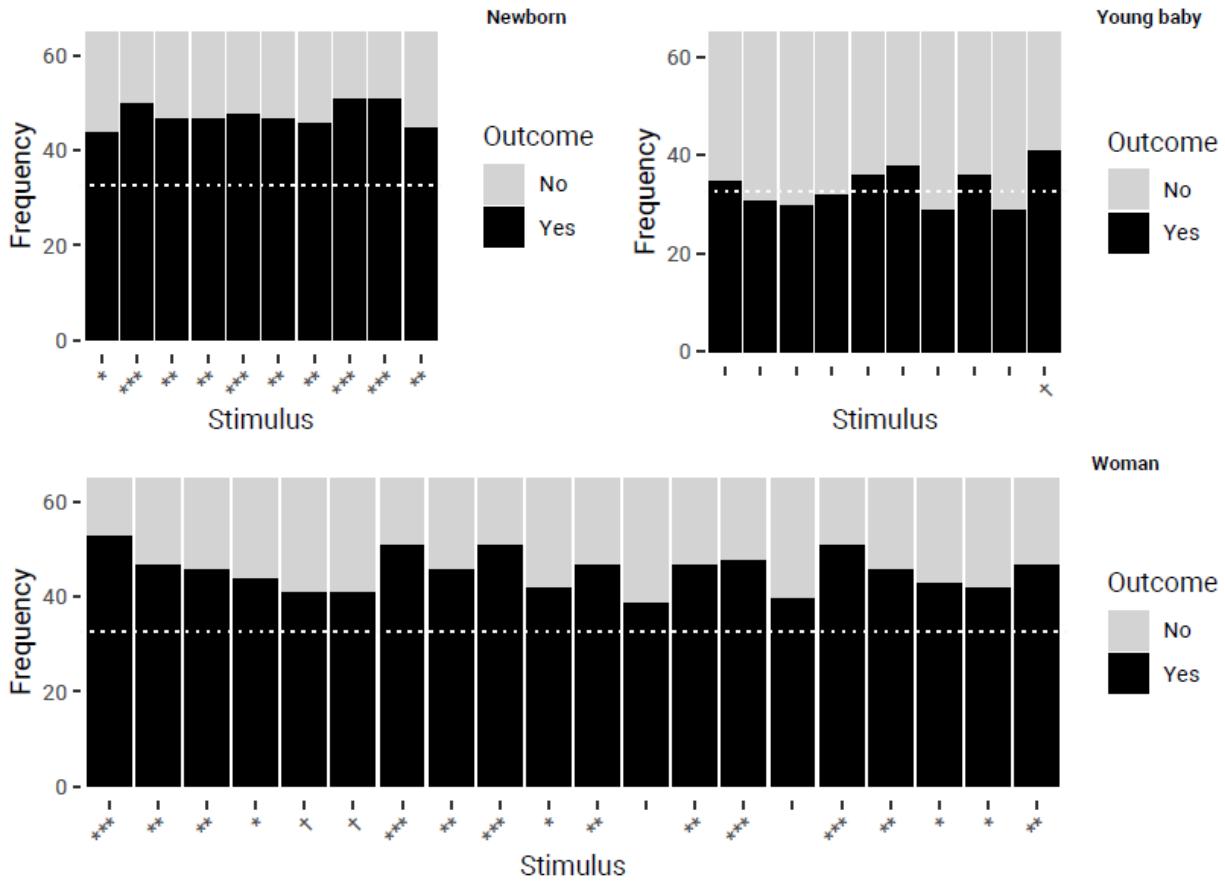


Figure 4: Frequency with which the feminised woman or cuter newborn / young baby was chosen (Outcome = 'Yes') by the 65 child participants (dashed line represents 32.5 participants), † .0 5< p < .10, * p < .05, ** p < .01, *** p <.001 (Benjamini-Hochberg corrected)

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

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

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

3.3 Adults

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

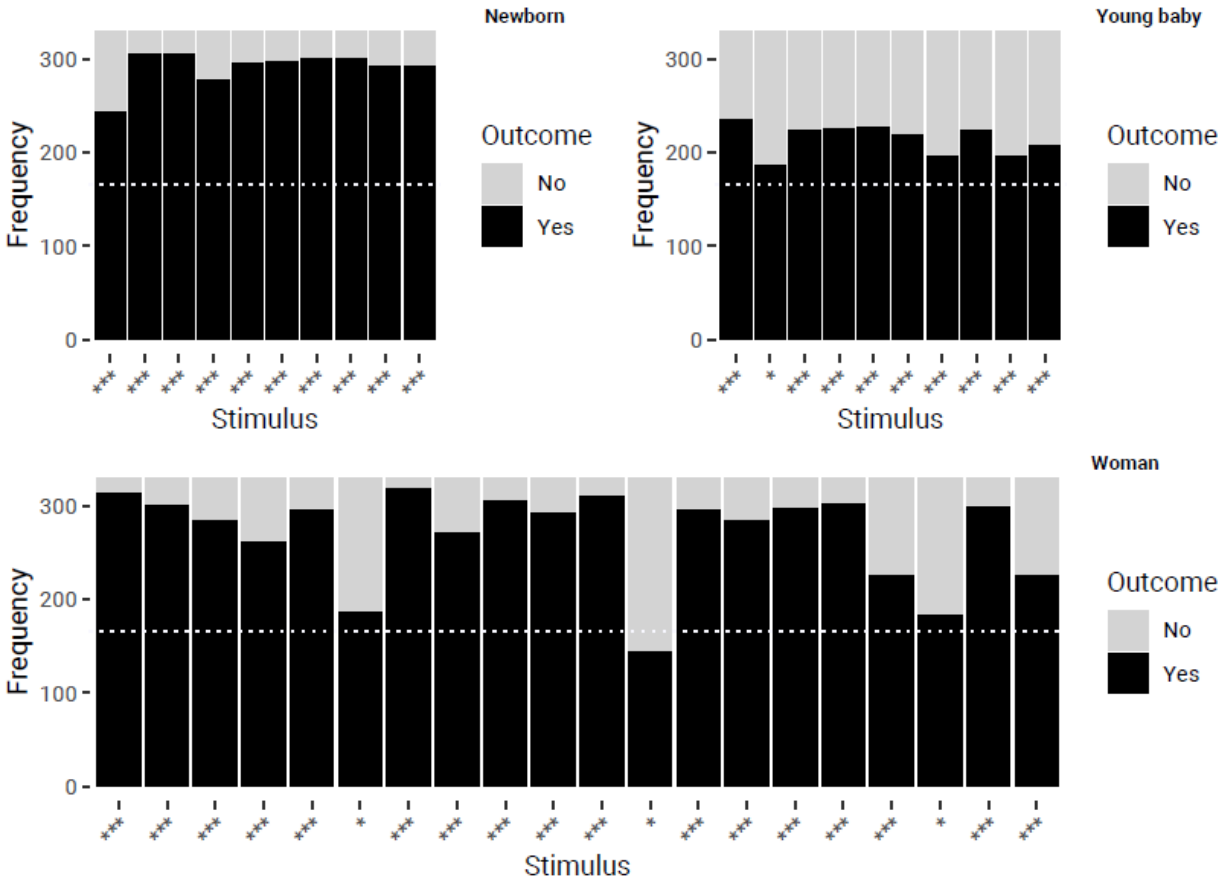


Figure 5: Frequency with which the feminised woman or cuter newborn / young baby was chosen (Outcome = 'Yes') by the 330 adult participants (dashed line represents 165 participants), * $p < .05$, *** $p < .001$ (Benjamini-Hochberg corrected).

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

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

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

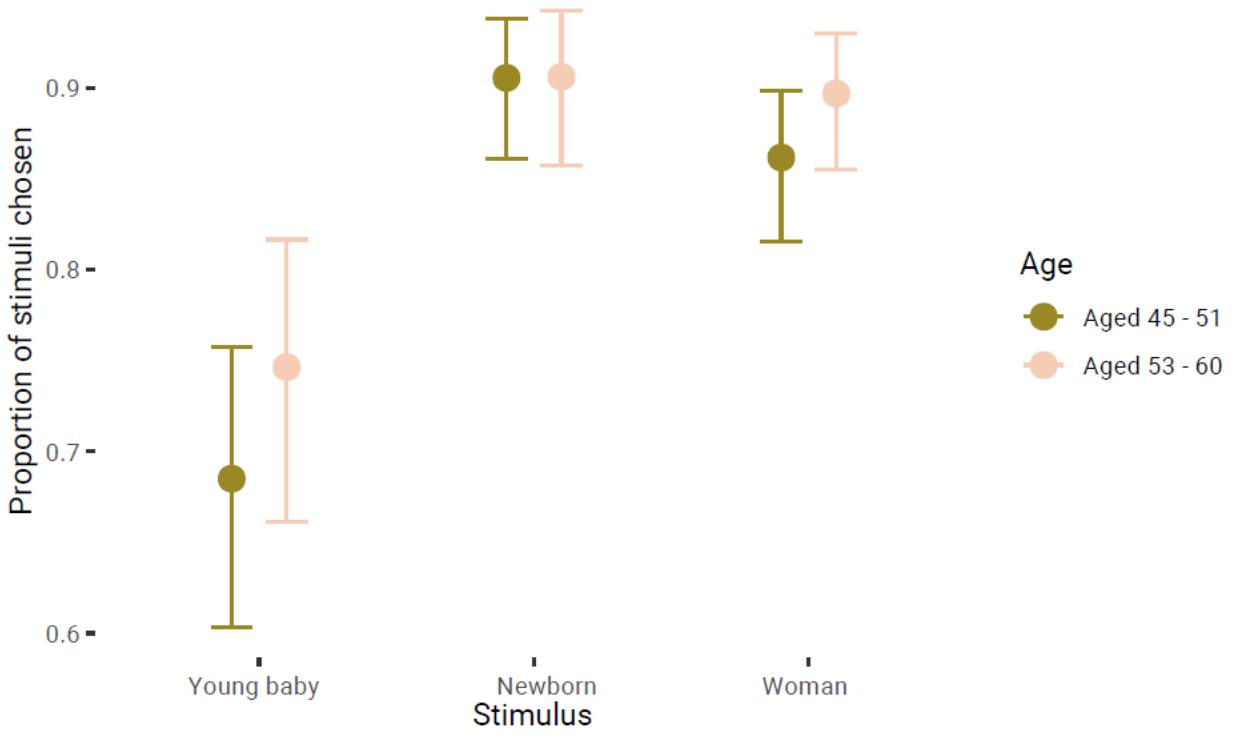


Figure 6: Interaction between stimulus type and purported pre- and post-menopausal age group (women aged 45 - 51 vs aged 53 - 60), in relation to the proportion of stimuli selected as cuter (newborn or young baby stimuli) or more attractive (woman stimuli). 0.5 = chance levels; error bars are 95% CIs.

4 Discussion

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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