Baby Schema in Infant Faces Induces Cuteness Perception and Motivation for Caretaking in Adults

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Abstract

Ethologist Konrad Lorenz proposed that baby schema ('Kindchenschema') is a set of infantile physical features such as the large head, round face and big eyes that is perceived as cute and motivates caretaking behavior in other individuals, with the evolutionary function of enhancing offspring survival. Previous work on this fundamental concept was restricted to schematic baby representations or correlative approaches. Here, we experimentally tested the effects of baby schema on the perception of cuteness and the motivation for caretaking using photographs of infant faces. Employing quantitative techniques, we parametrically manipulated the baby schema content to produce infant faces with high (e.g. round face and high forehead), and low (e. g. narrow face and low forehead) baby schema features that retained all the characteristics of a photographic portrait. Undergraduate students (n = 122) rated these infants' cuteness and their motivation to take care of them. The high baby schema infants were rated as more cute and elicited stronger motivation for caretaking than the unmanipulated and the low baby schema infants. This is the first experimental proof of the baby schema effects in actual infant faces. Our findings indicate that the baby schema response is a critical function of human social cognition that may be the basis of caregiving and have implications for infant–caretaker interactions.

Introduction

Ethologist Konrad Lorenz suggested that certain infant characteristics evoke a positive affective response in the human. He described the baby schema ('Kindchenschema') as a set of infantile physical features such as the large head, high and protruding forehead, large eyes, chubby cheeks, small nose and mouth, short and thick extremities and plump body shape, that is perceived as cute or cuddly and elicits caretaking behavior from other individuals (Lorenz 1943). In species whose young depend on care such bias could be adaptive and enhance offspring survival (Bowlby 1969; Eibl-Eibesfeldt 1989; Hrdy 2005). Responsiveness to baby schema may therefore provide a fundamental function of human social cognition.

Indeed, smiling is our initial reaction to infants (Hildebrandt & Fitzgerald 1978, 1981; Schleidt et al. 1980) and both children and adults consistently prefer pictures of infants over pictures of adults (Berman et al. 1975; Fullard & Reiling 1976). Additional support for Lorenz's concept comes from the film, toy and advertisement industries that capitalize on the baby schema, with the success of cartoon figures such as Walt Disney's Mickey Mouse (Gould 1979) as only one example. The majority of baby schema features appear in the head and the face and most prior research has focused on these infant characteristics. Studies employing line drawings and schematic faces manipulated selected components of the baby schema and confirmed that baby schema features elicit cuteness perception (Brooks &

Hochberg 1960; Hueckstedt 1965; Sternglanz et al. 1977; Alley 1981; McKelvie 1993) and caregiving responses (Alley 1983a; b). These studies employed drastically simplified stimuli, for example some focused on outlines of cephalic shapes (Hueckstedt 1965; Alley 1981, 1983b). Hence the relevance of these findings for adults' perception of infants remains questionable. Using photographs of infants, Hildebrandt & Fitzgerald (1979) correlated facial feature size with cuteness ratings. Their findings suggest that a cute infant has large eyes, a large forehead and short and narrow facial features. However, these results were not controlled for the individual facial differences unrelated to baby schema, such as hairstyle, eye color or facial symmetry. Hence, to date, there has been no experimental proof of the baby schema effects in actual infant faces.

The goal of the present study was to test the effects of baby schema on the adult's perception of cuteness and motivation for caretaking by controlled manipulation of baby schema in photographs of infant faces. Using graphic and morphing techniques, anthropometric methods (Farkas 1994) and the set of infant photographs previously reported by Hildebrandt & Fitzgerald (1979), we created infant faces with objectively quantified and parametrically manipulated baby schema content that retained all the characteristic of a photographic portrait. Infant faces with high (round face, high forehead, large eyes, small nose and mouth) and low (narrow face, low forehead, small eyes, large nose and mouth) baby schema were produced. Unmanipulated faces combining high and low baby schema features served as a control to exclude any effects of the manipulation procedure itself.

We hypothesized that baby schema in infant faces is perceived as cute and elicits motivation for caretaking in adults. As women tend to be more interested in infants and caretaking activities than men (Berman 1980; Maestripieri & Pelka 2002), we further hypothesized that women have a more pronounced response to baby schema than men.

Methods

Participants

Subjects were one hundred twenty two undergraduate students from Drexel University (Philadelphia, PA, USA); 66 students participated in the Cuteness Task and 56 students in the Caretaking Task. Of these, three subjects in the Cuteness Task and 10 subjects in the Caretaking Task were excluded because of current psychotropic drug use or substance abuse detected by a self-report screening questionnaire. Three additional participants who did not select any rating for more than 20 percent of the presented faces were also excluded. This left for statistical analysis a total of 62 participants (36 women, 26 men) in the Cuteness Task and 44 participants (25 women, 19 men) in the Caretaking Task. For the final sample, subjects' average age was 19.1 years (SD = 2.0 years) and their average education was 12.8 years (SD = 1.3 year). Ten participants self-identified as African Americans, 19 as Asians, 61 as Caucasians, two as Hawaiians and five as mixed ethnicity; nine did not report their ethnicity. The study protocol was approved by the Institutional Review Boards of the University of Pennsylvania and Drexel University and informed written consent was obtained from all participants.

Stimuli

Overview

Baby schema was operationalized using facial features recognized as typical anatomical infant characteristics that have previously been suggested to contribute to the baby schema response (Alley 1981; Brooks & Hochberg 1960; Enlow 1982; Hildebrandt & Fitzgerald 1979; Hueckstedt 1965; Lorenz 1970; Sternglanz et al. 1977), including face width, forehead height and eye, nose and mouth size. We applied standard anthropometric measures (Farkas 1994) and graphic and morphing techniques to a set of independently validated infant photographs (Hildebrandt & Fitzgerald 1979) to produce infant faces with parametrically manipulated baby schema content consisting of high (round face, high forehead, big eyes, small nose and mouth), low (narrow face, low forehead, small eyes, big nose and mouth) and unmanipulated baby schema portraits of each infant (Table 1, Fig. 1). To maintain normal facial appearance (Farkas 1994), we measured baby schema in a sample of 40 unmanipulated infant faces and used the range of baby schema values in this sample as a guide for our manipulations.

Stimuli creation procedure

The stimuli were based on a set of 60 chromatic infant photographs consisting of five male and five female caucasian infants at each of the ages of 3, 5, 7, 9, 11 and 13 months with a neutral facial expression (Hildebrandt & Fitzgerald 1979). Pictures were digitized at 72 dpi and 432×640 pixels in size. To minimize age effects, a sub-sample of 40 infants

Table 1: Overview of the baby schema manipulation procedure. On the basis of measurements in a sample of unmanipulated infants, facial parameters above (↑) or below (↓) the mean were classified as either high or low baby schema features, respectively. To maintain normal facial proportions, all manipulations were restricted to a range of +/−2 standard deviations

	Face width	Forehead length/Face length	Eye width/Face width	Nose length/Head length	Nose width/Face width	Mouth width/Face width
High baby schema	↑	↑	↑	↓	↓	↓
Low baby schema	↓	↓	↓	↑	↑	↑

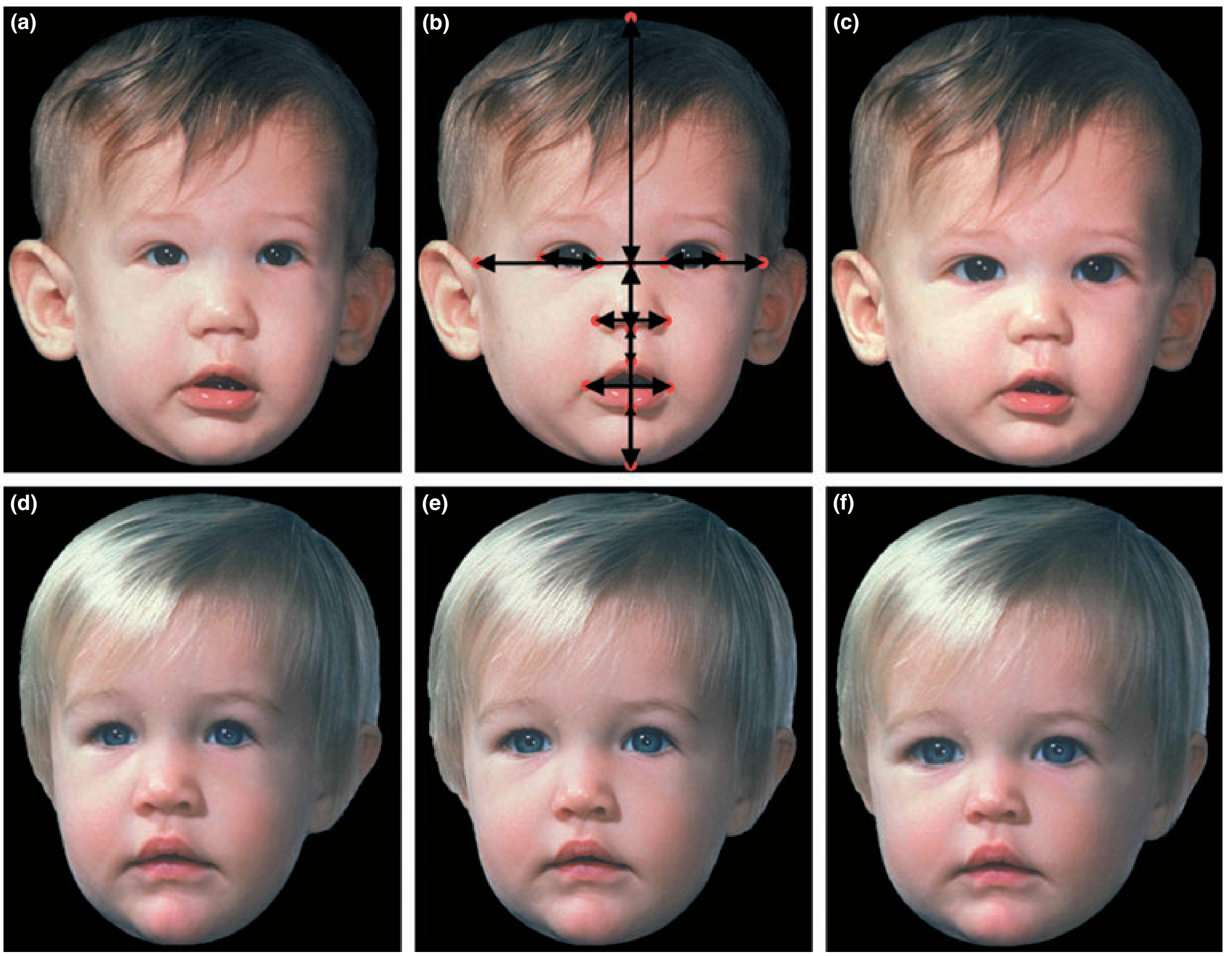

Fig. 1: Examples of low (a,d), unmanipulated (b,e) and high (c,f) baby schema infant faces. Facial landmarks (red dots) and measures (black arrows) are displayed in the unmanipulated portrait of the infant in the top row (b).

between 7 and 13 mo of age was selected. Faces were two-dimensionally straightened and cropped to a head length (hl) of 500 pixels.

Facial measurements were conducted by measuring distances between facial landmarks using the Photoshop measure tool (Adobe Systems, San Jose, CA, USA). The unit of measurement was pixel. A coordinate system was aligned on top of the face so that the x-axis connected the inner corner of the eyes and the y-axis originated at the base of the nose and traversed the midline of the face. The name and location of landmarks were adapted from anthropometric definitions (Farkas 1994) and included the Vertex (top of the head), Gnathion (bottom of the chin), the outer edges of the face along the x-axis, Endocanthi (inner corners of the eyes), Exocanthi (outer corners of the eyes), Nasion (nose base at the crossing of the x- and y-axis), Subnasale (below the tip of the nose), Alare (widest point on nose wing), Labiale superius (midpoint of the upper lip line), Labiale inferius (midpoint of the lower lip line) and the Cheilion (outer edge of the mouth; Fig. 1b). The following distances between landmarks were measured: Head Length (hl, Vertex to Gnathion), Face width (fw, distance between the outer edges of the face along the x-axis), Forehead length (fol, Vertex to Nasion), Face length (fal, Nasion to Gnathion), Eye width (ew, Endocanthus to Exocanthus), Nose length (nl, Nasion to Subnasale) and Nose width (nw, Alare to Alare), Mouth width (mw, Cheilion to Cheilion), Distance between nose and mouth (Subnasale to Labiale superius) and the distance between mouth and chin (Labiale inferius to Gnathion; Fig. 1b). Eye height was not measured due to the potential confound of eyelid position, instead the average ew was calculated from the right and left ew and served as a marker for eye size. The measurements were highly reliable with correlations between two experimenters ranging from 0.80 to 0.99 (Pearson correlation) with a mean of 0.92.

Baby schema was captured by six facial parameters: fw as an absolute measure in pixels with reference to the head length of 500 pixels and the five proportion indices fol/fal, ew/fw, nl/hl, nw/fw and mw/fw, which represent the relative size in percentage of one facial measure to another. The mean and standard deviation for each baby schema parameter was calculated from the sample of unmanipulated infants (fw: mean = 317.4, SD = 14.0, fol/fal: mean = 130.8, SD = 10.8, ew/fw: mean = 18.5, SD = 0.9, nl/hl: mean = 14.8, SD = 0.9, nw/fw: mean = 24.3, SD = 1.6, mw/fw: mean = 28.4, SD = 2.1). Based on these measures, we quantified the average amount of baby schema in this sample of infant faces. These measures served to classify facial parameters in an infant's face as high or low baby schema features, respectively (high baby schema: fw, fol/fal, ew/fw > mean, nl/hl, nw/fw, mw/fw < mean; low baby schema: fw, fol/fal, ew/fw < mean, nl/hl, nw/fw, mw/fw > mean; Table 1). Unmanipulated infants often combined high and low baby schema features, for example an infant's ew/fw may be above the average and therefore a high baby schema feature, whereas its nw/fw may also be above the average and therefore a low baby schema feature. The values of each facial parameter were converted to z-scores and total baby schema was quantified as the mean baby schema feature.

Facial baby schema was manipulated based on the above baby schema classification. The goal was to create infant portraits displaying either high or low baby schema features. Forehead height was enlarged or reduced using the software Morph Age (eX-cinder, http://www.creaceed.com). The head was re-scaled to a length of 500 pixels. As a next step, fw was manipulated, followed by eye size, nl, nw and mw using the software Face Filter Studio (Reallusion Inc, http://www.reallusion.com). The degree of manipulations was determined by the amount of baby schema present in an unmanipulated infant's face. For example, an infant with an already wide face may not have needed any more adjustments in fw to create its high baby schema version, only manipulations in other baby schema features. To maintain normal facial appearance (Farkas 1994), the range of manipulations for each baby schema parameter was restricted to a z-score range of +/−2 standard deviations (SD). Faces were re-measured and the new baby schema feature z-scores calculated. Two additional parameters (the position of the Endocanthi along the x-axis and the distance between nose and mouth/Distance between mouth and chin), that were affected by the manipulation procedure, were re-adjusted to their approximate original position or proportion index, respectively. Finally, an infant's skin colour was re-matched to its unmanipulated version (Photoshop; Adobe Systems, San Jose, CA, USA). The background of all pictures was set to black (Photoshop; Adobe Systems).

Using this protocol, 17 infants (eight boys, nine girls) were manipulated for their amount of baby schema. This resulted in a set of 51 faces consisting of 17 high (mean total baby schema z-score = 1.0, SD = 0.2), 17 low (mean total baby schema z-score = −1.1, SD = 0.1) and 17 unmanipulated baby schema infant portraits (mean total baby schema z-score = 0, SD = 0.3; see Fig. 1 for examples).

Experimental Procedure

Subjects were alternately assigned to participate in the Cuteness Task or the Caretaking Task. In the Cuteness Task, participants were asked to rate the cuteness of each infant ('how cute is the infant?') and in the Caretaking Task, they were asked to rate the extent of their motivation to take care of the infant in the picture ('how much does the infant make you feel that you would like to take care of it?'). The 5-point rating scales ranged from 1 'Not Very Cute' to 5 'Very Cute' and from 1 'Would Not Very Much Like To Take Care Of' to 5 'Would Very Much Like To Take Care Of', respectively. In both tasks, participants were informed that each infant will be shown in several different ways and were asked to rate each picture separately. Computerized tasks presented the 17 high, 17 low and 17 unmanipulated baby schema infant faces in random order. Each face was displayed along with the rating scale for 4 s followed by a crosshair presentation for 2 s. Subjects used a computer mouse to rate the faces while they were on the screen. All ratings were recorded. If participants did not respond, a missing value was assigned as response to the stimulus. Total task duration was 5 min and 6 s (51 faces × (4 + 2) s). Tasks were presented using custom made web-based image presentation software running on Apple Macintosh computers. Participants were tested in groups of up to twenty students as part of 1-h neurobehavioral testing sessions that included other tasks such as verbal memory tests; no other task presented infant faces.

Statistical Analysis

A 3*2 (Baby Schema*Gender) repeated-measures ANOVA was performed, where baby schema was a within-subject factor and gender a between-subjects factor, with cuteness and caretaking motivation ratings as outcome variables. Significant interactions were further investigated using two-tailed paired-samples t-tests. The level for rejecting the null hypothesis was set at $p \leq 0.05$, and graphic presentation of results used means and +/−1 standard error. All statistical procedures were performed with SPSS (SPSS Inc., Chicago, IL, USA) implemented on a Windows platform.

Results

Cuteness Ratings

The main effect of baby schema on cuteness ratings was significant ($F_{(2,\ 59)} = 137.3$, $p < 0.001$). Pairwise comparisons employing Bonferroni corrections reveal that high baby schema infants were rated as more cute than the unmanipulated and the low baby schema infants (high vs. low $p < 0.001$, high vs. unmanipulated $p < 0.001$, unmanipulated vs. low $p < 0.001$; Fig. 2a). There was neither a significant main effect of gender ($F_{(1,\ 60)} = 1.9$, $p = 0.18$) nor a significant interaction between gender and baby schema ($F_{(2,\ 59)} = 0.4$, $p = 0.71$).

Caretaking Motivation Ratings

There was a significant main effect of baby schema on caretaking motivation ratings ($F_{(2,\ 41)} = 40.0$, $p < 0.001$). Pairwise Bonferroni-corrected comparisons show that high baby schema infants received higher caretaking motivation ratings than the unmanipulated and the low baby schema infants (high vs. low $p < 0.001$; high vs. unmanipulated $p < 0.005$; unmanipulated vs. low $p < 0.001$; Fig. 2b). There was no significant main effect of gender ($F_{(1,\ 42)} = 0.6$, $p = 0.5$), but the interaction between gender and baby schema was significant ($F_{(2,\ 41)} = 3.6$, $p < 0.05$). Both women and men gave higher caretaking motivation

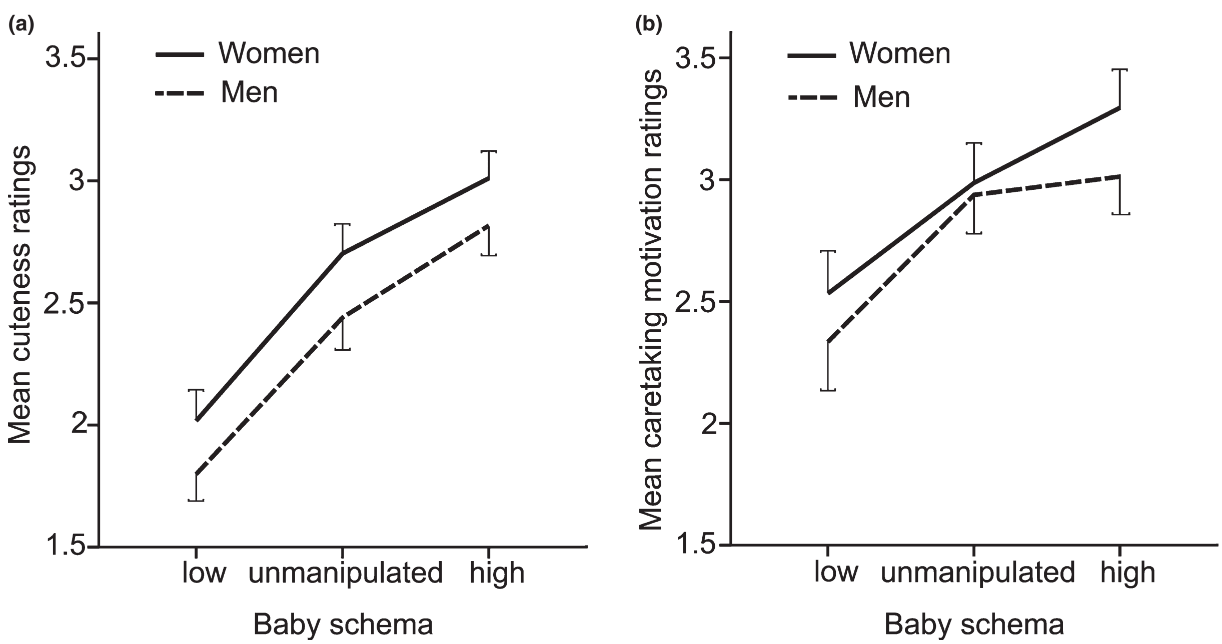

Fig. 2: Mean cuteness (a) and caretaking motivation (b) ratings for the low, unmanipulated and high baby schema infants in women (solid lines) and men (dashed lines). Error bars represent +/−1 SE, respectively.

ratings to high and unmanipulated baby schema infants than to low baby schema infants (Women: high vs. low, $t = 6.8$, $df = 24$, $p < 0.001$, unmanipulated vs. low, $t = 7.7$, $df = 24$, $p < 0.001$; Men: high vs. low, $t = 4.8$, $df = 18$, $p < 0.001$, unmanipulated vs. low, $t = 5.4$, $df = 18$, $p < 0.001$). Women also selected higher caretaking motivation ratings for the high baby schema infants than for the unmanipulated infants ($t = 4.7$, $df = 24$, $p < 0.001$), but men did not ($t = 0.8$, $df = 18$, $p = 0.42$ ns; Fig. 2b).

Discussion

Our results provide the first experimental proof that baby schema in infant faces is perceived as cute and induces motivation for caretaking in adults. These findings are consistent with previous studies that used less ecologically valid stimuli (Brooks & Hochberg 1960; Hueckstedt 1965; Sternglanz et al. 1977; Alley 1981, 1983b; McKelvie 1993) or a correlative approach (Hildebrandt & Fitzgerald 1979). The combination of graphic and morphing techniques with anthropometric methods allowed us to experimentally manipulate baby schema in actual infant faces and provide quantitative demonstration of the phenomena implied by the prior research.

Our findings have implications for infant–caretaker interactions. Cute infants are rated as more likeable, friendly, healthy and competent than the less cute infants (Maier et al. 1984; Stephan & Langlois 1984; Karraker & Stern 1990; Ritter et al. 1991; Casey & Ritter 1996), an effect that may be mediated by the baby schema. Furthermore, cute infants are rated as most adoptable (Volk & Quinsey 2002; Chin et al. 2006). The baby schema response can have behavioral consequences. For example, cute infants are looked at longer (Hildebrandt & Fitzgerald 1978), and mothers of more attractive infants are more affectionate and playful (Langlois et al. 1995). Other factors such as an infant's behavior or the caretaker's familiarity with the infant may also be important for adult's evaluation of children (e. g., Koyama et al. 2006). Nevertheless, our results show that baby schema in infant faces is an intrinsic trigger of cuteness perception and motivation for caretaking. This effect generalizes to adult faces with enlarged eyes and lips who elicit more helping behavior than their mature counterparts (Keating et al. 2003).

As expected, we found sex differences in the baby schema response. Baby schema induced stronger caretaking motivation in women yet there were no sex differences in cuteness ratings. Although the perception of the baby schema may be equal in women and men, the bias toward caregiving motivation in women could be evolutionary advantageous, considering that they are the primary caregivers in most societies (Eibl-Eibesfeldt 1989). Our findings indicate that the previously reported sex differences in the interest in infants (Berman 1980; Maestripieri & Pelka 2002) are likely caused by differences in the motivation to interact with infants rather than due to perceptual differences. This may also explain the inconsistent occurrence of sex differences in prior reports on the effects of baby schema features (Alley 1983a, b; Hueckstedt 1965; Sternglanz et al. 1977).

Recent anthropological research may provide a theoretical framework for the human response to baby schema: Unlike nuclear families, in which the mother nurtures while the father provides, human ancestors are hypothesized to have evolved as cooperative breeders (Hrdy 2005). Such social system is characterized by the spread of the caretaker role to group members other than the mother, for example older women and children. Baby schema could motivate caretaking behaviors towards any infant, from any potential caregiver in a group, regardless of kinship. Females are hereby the main source of 'allomothers' (Hrdy 2005), which would be consistent with their stronger caretaking motivation response to baby schema found in our study.

Our study has several limitations. We restricted our manipulations to the face and did not take into account baby schema features of the body such as the short and thick extremities. In addition, some relevant facial features such as the curvature of the forehead and chubby cheeks were not included in our manipulations because an adequate method for measuring these characteristics from photographs was not available. We nevertheless believe that our study adequately represented baby schema, as the majority of baby schema features appear in the head and face and most of them were captured by our manipulations. Finally, though we did not control for participants' previous experience with infants, all of our participants were undergraduate students (average age 19.1 years), a cohort that rarely has children (Alley & Baron 1986; Karraker & Stern 1990). Therefore experience with infants is unlikely to confound the sex differences we report.

In conclusion, we demonstrated that the amount of baby schema in an infant's face drives cuteness perception and motivation for caretaking in adults. Our findings indicate that the baby schema response is a fundamental function of human social cognition that may be the basis of caregiving and have implications for infant–caretaker interactions.

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