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Psychophysiological Responses to *Kawaii* Pictures With or Without Baby Schema

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Abstract

Baby schema has been considered a key stimulus that triggers feelings and thoughts of cuteness. *Kawaii* is a Japanese word that roughly translates to *cute* in English, but its meaning appears to be broader than cute. Specifically, cuteness is often regarded as synonymous with infant physical attractiveness, whereas *kawaii* is used not only for babies but also for noninfantile objects. In this study, psychophysiological responses were compared between two types of *kawaii* pictures: human babies and animals (*kawaii* with baby schema) or objects such as desserts and dress accessories (*kawaii* without baby schema). Twenty female university students were asked to view various pictures twice. Both types of *kawaii* pictures were rated to be more pleasant than neutral pictures, elicited a greater activation of the zygomaticus major muscles associated with smiling, and were viewed for a longer period when the same pictures were presented again. The effect of baby schema appeared in the zygomaticus major muscle activity, which was greater for pictures with baby schema. The findings suggest that the word *kawaii* expresses positive feelings that are more generic than infant attractiveness and that are associated with a motivation to approach a preferable object.

Keywords

cuteness, baby schema, facial electromyogram, viewing duration, approach motivation

In present-day Japan, the word *kawaii* prevails in every scene, including fashion, advertisements, and product designs. The word and the phenomenon have often been regarded as a representative of Japanese pop culture (Botz-Bornstein, 2011; Kinsella, 1995; Okazaki & Johnson, 2013; Yomota, 2006). Because various stimuli are expressed as *kawaii*, it is difficult to define what *kawaii* is in general. The word is often translated into English as *cute*. However, the two words seem to differ in nuance. Specifically, cuteness has been regarded as synonymous with infant physical attractiveness (Hildebrandt, 1983; Karraker & Stern, 1990), whereas *kawaii* is used more widely referring to broader categories of stimuli that do not necessarily have infantile features. Because the word and the culture of *kawaii* are getting known in the world and because more and more researchers are involved in the research on cuteness and use the term *kawaii* in their articles (e.g., Buckley, 2016; Dale, Goggin, Leyda, McIntyre, & Negra, 2017; Kringelbach, Stark, Alexander, Bornstein, & Stein, 2016), it is important to explain the commonalities and differences between cute (in a classical sense) and *kawaii*. Although the word *kawaii* is originally an adjective, we used it as a noun in this article.

Previous studies regarding cuteness have revolved around the concept of *Kindchenschema* (Lorenz, 1943). As an ethologist, he conceived that there is an innate releasing mechanism that makes humans feel cute and promotes nurturing and protection behaviors in response to particular stimuli. Baby schema is the physical characteristics that are typically possessed by young animals and babies, such as a large head compared with the body, a rounded body shape, and a soft body surface. Empirical studies have shown that infant faces with higher baby schemas are perceived to be cuter (Alley, 1981; Glocker et al., 2009a; Little, 2012; Lobmaier, Sprengelmeyer, Wiffen, & Perrett, 2010; Sprengelmeyer et al., 2009), are viewed for a longer period (Parsons, Young, Kumari, Stein, & Kringelbach, 2011; Sprengelmeyer, Lewis, Hahn, & Perrett, 2013) even by 3- to 6-year-old children (Borgi, Cogliati-Dezza, Brelsford, Meints, & Cirulli, 2014), activate brain areas related to reward and emotional processing such as the nucleus accumbens and amygdala (Glocker et al., 2009b; Zebrowitz, Luevano, Bronstad, & Aharon, 2009), and increase the motivation for caregiving (Alley, 1983a, 1983b; Glocker et al., 2009a). Moreover, industrial products (e.g., cars) with baby schema are evaluated to be cuter (Miesler, Leder, & Herrmann, 2011; see Cheok &

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Fernando, 2012, for its application to interactive media). Although a few exceptions exist (e.g., Nenkov & Scott, 2014), previous research on cuteness has mainly dealt with babies or infant-related features (see Kringelbach et al., 2016, for a recent review). As the Japanese word *kawaii* is often used to refer to such objects, cute and *kawaii* have a similar meaning in this respect.

However, there are other types of stimuli that are referred to as *kawaii* but are not directly related to babies. Ihara and Nittono (2011; see also Nittono, 2016) conducted a survey on 166 university students about 93 animate and inanimate objects (expressed in either words or short phrases) that were sometimes described as *kawaii*. Half of the raters were asked to judge the degree of *kawaii* of each item on a 5-point scale, whereas the other half judged the infantility of the stimuli. As a whole, a moderate positive correlation was found between the mean rating scores of *kawaii* and infantility across the 93 items ($r = .50$). However, items also existed that were high in *kawaii* and low in infantility (e.g., smile, cheerful person, flower, dessert, and dress accessory). In a second study, Ihara and Nittono (2012; see also Nittono, 2016) searched for common psychological factors in the feelings toward various stimuli that are often referred to as *kawaii*. Japanese university students ($N = 180$) were asked to imagine a scene in which they encountered each of the four types of *kawaii* stimuli: those with baby schema (e.g., babies, stuffed animals), humans (e.g., smiling, cheerful person), nonliving objects (e.g., desserts, accessories), and idiosyncratic objects that are not usually described as *kawaii* although the respondents personally feel them to be *kawaii* (e.g., lizards, mushrooms). They then rated their feelings and thoughts on six 5-point scales: two adjectives (*kawaii, infantile*), two scales of approach motivation (*I want to be closer to it, I want to keep it nearby*), and two scales of nurturance motivation (*I want to help it when it is in trouble, I want to protect it*). Results showed that the profiles of the six rating scores differed in shape significantly across the four types of *kawaii*, which suggests that psychological states associated with these *kawaii* stimuli differ. However, partial correlation analyses revealed that higher *kawaii* ratings were associated with a greater approach motivation, but not with a greater nurturance motivation, for all types of *kawaii*. This finding is inconsistent with the baby schema hypothesis, which implies that the feelings of *kawaii* are linked with caregiving and protection. Rather, the feelings of *kawaii* are related to a strong approach motivation to interact with the stimulus.

In this exploratory study, we compare psychophysiological responses with *kawaii* stimuli with baby schema (e.g., babies, infants), which are typical examples of cute stimuli, and *kawaii* stimuli without baby schema (e.g., desserts, accessories), which are less well studied, to understand the feelings of *kawaii* more extensively. Because these pictures can be regarded as affective stimuli, we recorded psychophysiological responses to these pictures by following a standard research protocol of affective picture processing (Lang, Greenwald, Bradley, & Hamm, 1993). Subjective ratings (*pleasant, unpleasant, arousing, kawaii, infantile*, and *I want to approach*), facial electromyograms (EMGs), skin conductance response (SCR), and viewing duration were recorded.

Field observation studies have shown that babies and infants make us smile and move us to approach them (Nishiyama, Oishi, & Saito, 2015; Schleidt, Schiefenhovel, Stanjek, & Krell, 1980). When a facial EMG is recorded in laboratory studies, pictures of babies elevate the activity of the zygomaticus major muscles, which are associated with smiling (Bradley, Codispoti, Cuthbert, & Lang, 2001; Hildebrandt & Fitzgerald, 1978; Lang et al., 1993). The effect is not limited to living things. Miesler et al. (2011) manipulated the front designs of cars to enhance baby schema features (e.g., enlarging the headlights [eyes] and shrinking the middle grill [nose]) and asked participants to judge the attractiveness and cuteness of the objects. When the participants rated cuteness (but not when they rated attractiveness), baby-faced car fronts induced a higher level of zygomaticus major muscle activity. Another measure, viewing duration, also varies with cuteness. Viewing duration has been shown to increase for novel stimuli (Berlyne, 1960; Silvia, 2006) and for high-arousal positive and negative stimuli (Lang et al., 1993). Recent research showed that positive stimuli were viewed longer than negative stimuli when the stimuli had been presented before (Kron et al., 2014). When participants can adjust their viewing time, faces with higher baby schema are looked at for a longer period (Parsons et al., 2011; Sprengelmeyer et al., 2013). Interestingly, previous studies reported that the subjective rating of cuteness was positively correlated with viewing duration, but not correlated with the level of zygomaticus major muscle activity (Hildebrandt & Fitzgerald, 1978; Nittono, 2011). Therefore, facial EMG and viewing duration measures can produce different patterns of results.

Because no standardized stimulus set exists for *kawaii*, we presented a number of pictures to the participants and made a post hoc selection of the stimulus sets that are controlled in their levels of *kawaii*, pleasantness, and arousal according to the participants' rating scores. By doing so, we can compare the patterns of subjective, behavioral, and physiological measures that co-occur in the same participants. We examined whether the known responses to *kawaii* pictures with baby schema (e.g., increases in positive subjective ratings, zygomaticus major muscle activity, and voluntary viewing duration) also occur in response to *kawaii* pictures without baby schema. Moreover, only women were recruited in this study because women are more sensitive and responsive to cuteness in infants (Hahn, Xiao, Sprengelmeyer, & Perrett, 2013; Lehmann, Huis in't Veld, & Vingerhoets, 2013; Lobmaier et al., 2010; Sprengelmeyer et al., 2009; see also Berman, 1980, for the importance of situational variables) and to *kawaii* stimuli in general (Nittono, 2016).

Method

Participants

Twenty female university students (20-27 years old, M = 22.2 years) participated in the study. All declared that they had normal or corrected-to-normal vision. They were right handed according to the Edinburgh Handedness Inventory (Oldfield, 1971). The protocol was approved by the Research Ethics Committee of the Graduated School of Integrated Arts and Sciences, Hiroshima University. Written informed consent was obtained from the participants.

Stimuli

In total, 40 color pictures were selected from the Internet through a Google image search. To make the stimuli vary in the levels of *kawaii* and infantility, *kawaii* and infantile pictures (e.g., baby), *kawaii* and less infantile pictures (e.g., dessert plate), less *kawaii* and infantile pictures (e.g., preterm infant), and less *kawaii* and less infantile pictures (e.g., adult male face) were selected through a discussion among three female university students who did not serve as participants. The materials and the data are available from the corresponding author on request.

Procedure

Participants were tested individually in a sound attenuated room. The experiment consisted of two sessions. The participants first rated 40 pictures one by one while recording psychophysiological measures and they then viewed the pictures again as long as they wished. This two-step procedure was adapted according to a classic study on affective picture processing (Lang et al., 1993). The pictures were presented with Inquisit 3.0 (Millisecond software, USA) on a 21-inch cathode ray tube display placed 100 cm in front of the participants' eyes. Each picture extended to fit within a 30 cm by 30 cm frame (visual angle = 17°).

In the rating session, each trial started with a screen with a serial number for 2 s. Next, a fixation cross appeared for 6 s. Then, each picture was presented for 6 s in a randomized order. During this period, facial EMGs and SCRs were recorded. After the offset of each picture, a rating screen appeared. The participants judged their impressions of the picture on six 6-point scales (*pleasant, unpleasant, arousing, kawaii, infantile*, and *I want to approach*; 1 = *not at all*, 6 = *very much*). Among them, the item *I want to approach* was a dependent measure of primary interest, whereas the other items were used for post hoc stimulus selection. When the participants clicked on the "Finish" button, the next trial started 1 s after. A short break was inserted after every 10 trials. Two practice trials were conducted at the beginning with pictures that were not used in the experiment.

In the free viewing session, the same pictures were presented again in a random order. When the participants clicked on a mouse button, a fixation cross appeared for 1.5 s, which was followed by a picture. They were instructed to view each picture as long as they wished and click on the mouse button again to move to the next trial, which started with a fixation cross. The interval (in milliseconds) between the picture onset and the mouse click was designated as the viewing duration. A short break was inserted after every 10 trials. Four practice trials with four different pictures were conducted at the beginning.

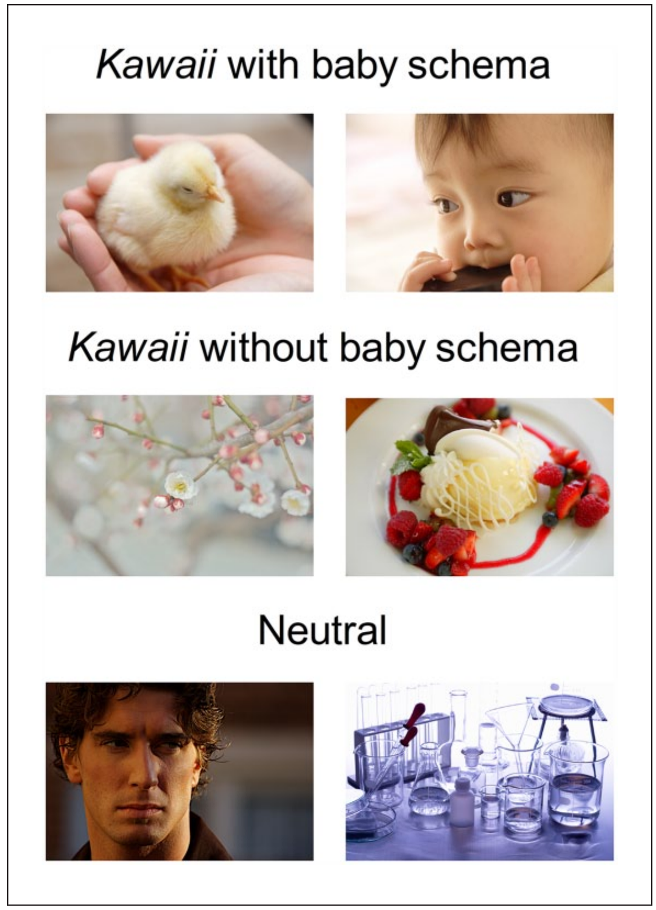

Figure 1. Sample pictures of two *kawaii* categories and the neutral category.

Note. These pictures were selected based on the mean subjective ratings of the 20 female participants of the present study. The mean *kawaii* ratings (1-6) were 4.9 (top left), 5.5 (top right), 4.2 (middle left), 4.8 (middle right), 1.6 (bottom left), and 1.9 (bottom right). Top photos: ©Yorikazu Inagaki (free license), middle left: ©Ichiro Takagi (free license), middle right: ©2010 Tomoyuki Kawashima (Creative Commons), bottom left: ©2007 Steve Punter (Creative Commons), bottom right: ©2007 Paylessimages, Inc./amanaimages (royalty free).

Post Hoc Stimulus Selection

After the experiment, the mean score of each rating scale was obtained by averaging the data of all participants (N = 20). Based on these mean rating scores, three categories of stimuli were selected from the 40 pictures. Figure 1 illustrates some examples of each category. Five pictures each were selected for the *kawaii* with baby schema category and the *kawaii* without baby schema category, so the scores of pleasant, unpleasant, arousing, and *kawaii* were equalized between the categories. The *kawaii* pictures with baby schema depicted a human baby's face without an expression and baby animals (chick, puppy, piglet, and white bear). The *kawaii* pictures without baby schema depicted blossoms, a dessert plate, macaroons, a wedding dress, and perfume bottles. The neutral category consisted of six pictures: an adult male face without expression, a tadpole, a newborn crocodile, scientific glassware, a men's suit, and a do-it-yourself toolbox. The former three pictures were living things (as a control for the *kawaii* pictures with baby schema) and the latter three pictures were nonliving things (as a control for the *kawaii* pictures without baby schema). The level of infantility was equalized between the neutral pictures and the pictures of the *kawaii* without baby schema. Because the total number of pictures was small, we could not set up two different neutral categories.

Physiological Measurements

Biosignals were recorded with a sampling rate of 1,000 Hz (filter settings: direct current to 200 Hz) using QuickAmp (Brain Products, Germany). The data were analyzed with Brain Vision Analyzer ver. 2.0 (Brain Products, Germany).

Facial EMG. The facial EMG activities of the corrugator supercilii muscles, which are associated with negative emotion (Lang et al., 1993), and of the zygomatic major muscles were recorded bipolarly over the left eyebrow and at the left cheek, respectively, according to the guidelines (Fridlund & Cacioppo, 1986). Ag/AgCl electrodes (4-mm diameter) were used. The recorded waveform was filtered with a digital highpass filter of 15 Hz (12 dB/oct), rectified by reversing the negative values into positive absolute values (Larsen, Norris, & Cacioppo, 2003). The mean value of the 6-s period after the stimulus onset was calculated. Visual inspection confirmed that there were no excessive artifacts in the analyzed period. The mean value of the 1-s period before stimulus onset was used as a baseline. To correct for the positive skewness of the EMG data, the mean values were subjected to a natural logarithm transformation. The difference between the baseline and the poststimulus period was calculated as Δcorrugator supercilii and Δzygomatic major. To understand the time course of facial EMGs, the mean values of seven 1-s periods from 1 s before to 6 s after stimulus onset were also calculated without a baseline correction.

SCR. The SCR was recorded with the canonical 0.5 V constant voltage method using a galvanic skin response (GSR) sensor of QuickAmp (Brain Product, Germany). Two Ag/AgCl electrodes filled with 0.05 M NaCl electrolytes were placed on the volar side of the middle phalanges of the index and middle fingers of the left hand. No highpass filter was used for recording or analysis. The SCR was visually inspected and its amplitude (in μS) was scored as the difference value between the initial deflection in the period of 1 to 4 s after stimulus onset and the peak within 5 s thereafter (Boucsein et al., 2012). Any response less than 0.01 μS was regarded as no response and coded as 0. To conform the data to the normal distribution, the amplitude value (μS) + 1 was converted to a natural logarithm. This transformation makes the amplitude value of no response trials 0. The mean amplitude across trials was calculated including no response trials.

Statistical Analysis

For subjective ratings, viewing duration, change scores of facial EMGs, and SCR amplitude, the mean values were calculated for the three stimulus categories. A one-way multivariate analysis of variance (MANOVA) with repeated measures was conducted for each measure. A MANOVA, rather than an ANOVA, was used because it can solve the Type I error inflation inherent in repeated-measures designs (Vasey & Thayer, 1987). To correct for the positive skewness, the viewing duration was converted to a natural logarithm. The time courses of facial EMGs were analyzed by two-way MANOVAs with the factors of stimulus category (3) and time (7). The significance level was set at .05. A post hoc comparison of means was made by Bonferroni t tests (two-tailed) with an adjusted comparison-wise significance level. Uncorrected p values are reported in the text, whereas significant differences after correction are shown in the figures. In addition, a picture-by-picture correlation analysis was conducted. For each of the 40 pictures, the mean value of each measure was calculated from all the participants' data ($N = 20$). A scatterplot showing the relationship between *kawaii* rating score and each measure was made. Spearman's rank correlation coefficient (r_s) was calculated because the values might not be normally distributed.

Results

Validity Check of Stimulus Selection

Figure 2 shows the mean values of subjective, behavioral, and physiological measures for each category of pictures. As described above, a post hoc selection of pictures was made in the present study. To check the validity of the manipulation, one-way MANOVAs were conducted. The pleasantness, unpleasantness, and *kawaii* scores differed across the three categories, $F(2, 18) = 51.70$, $p < .001$, $\eta_p^2 = .852$; $F(2, 18) = 39.10$, $p < .001$, $\eta_p^2 = .813$; and $F(2, 18) = 110.33$, $p < .001$, $\eta_p^2 = .925$, respectively. Multiple comparisons of means revealed that, compared with the pictures in the neutral category, the pictures in both *kawaii* categories were rated to be more pleasant, less unpleasant, and more *kawaii*. No significant differences were found between the two *kawaii* categories. The effect of

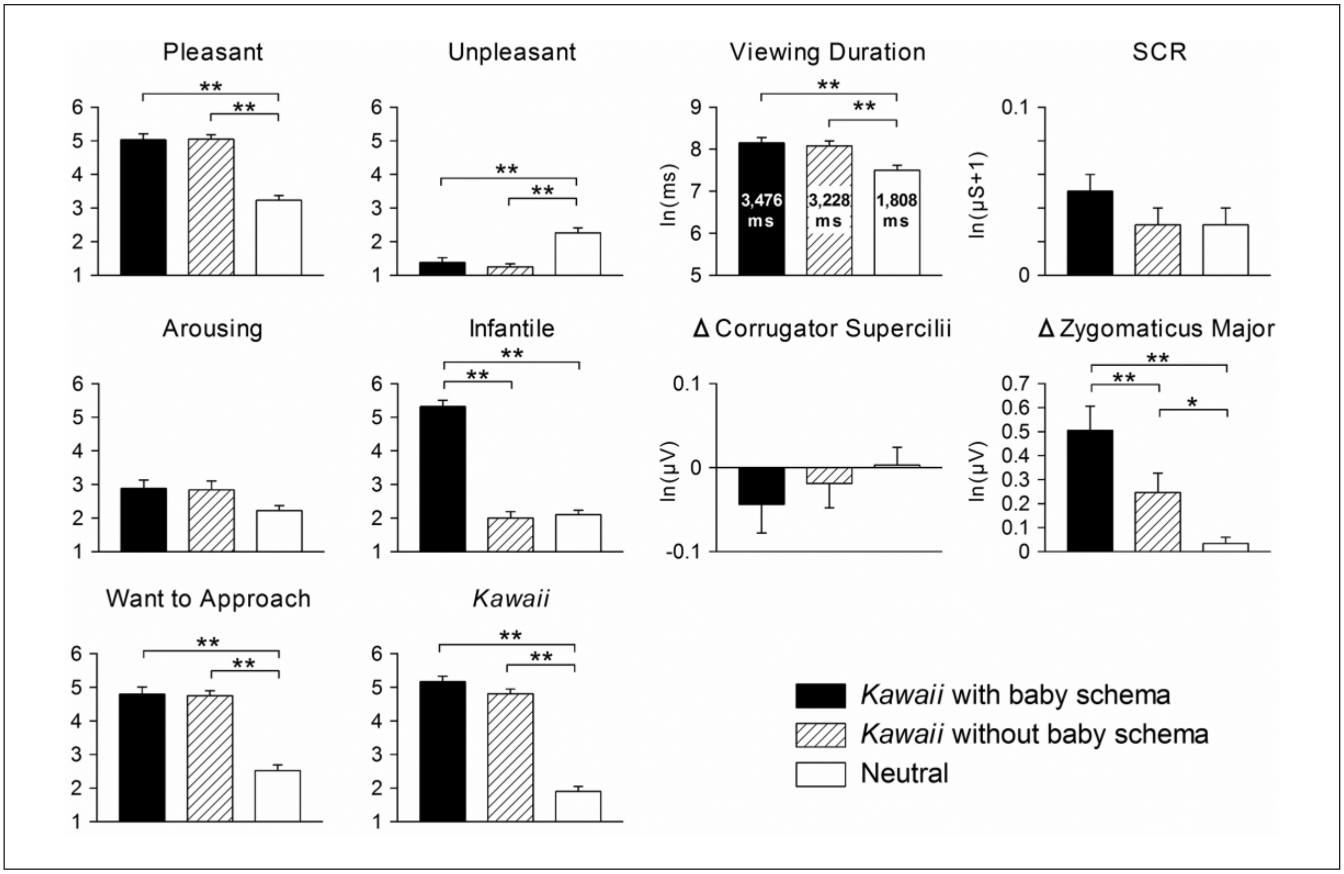

Figure 2. Subjective, behavioral, and physiological responses to the pictures of the three stimulus categories.
Note. Bar graphs and error bars show the means and standard errors of the five selected *kawaii* pictures with baby schema, the five selected *kawaii* pictures without baby schema, and the six selected neutral pictures, respectively. The numerical values on the viewing duration chart are geometric means. SCR = skin conductance response.
*p < .05 (p < .016 before Bonferroni correction). **p < .01 (p < .003 before Bonferroni correction).

category was significant also for the arousal score, $F(2, 18) = 3.59$, $p = .049$, $\eta_p^2 = .285$. Although the score was numerically higher for both the *kawaii* categories than for the neutral category, pairwise multiple comparisons did not reveal any significant difference. The infantility score differed significantly across categories, $F(2, 18) = 208.85$, $p < .001$, $\eta_p^2 = .959$. The *kawaii* pictures with baby schema were rated to be more infantile than the *kawaii* pictures without baby schema and the neutral pictures. In sum, these results confirmed the validity of the selection procedure.

Subjective Ratings

The subjective measure of approach motivation (*I want to approach*) varied across stimulus categories, $F(2, 18) = 75.43$, $p < .001$, $\eta_p^2 = .893$. A multiple comparison showed that, compared with the neutral pictures, both types of *kawaii* pictures were rated to be higher in this dimension, ts(19) = 8.72 and 12.62, ps < .001 for *kawaii* with baby schema and *kawaii* without baby schema, respectively, and did not differ from each other, $t(19) = 0.27$, $p = .791$.

Viewing Duration

The positive skewness of the viewing duration data was corrected after a natural logarithm transformation (from 2.25 to 0.01). Viewing duration also showed significant differences among stimulus categories, $F(2, 18) = 25.26$, $p < .001$, $\eta_p^2 = .737$. Regardless of the presence or absence of baby schema, *kawaii* pictures were viewed for a longer period than neutral pictures, ts(19) = 7.15 and 6.66, ps < .001 for *kawaii* with baby schema and *kawaii* without baby schema, respectively. No significant difference was found between the two types of *kawaii* stimuli, $t(19) = 1.34$, $p = .195$.

Psychophysiological Responses

The positive skewness of the EMG data was corrected after a natural logarithm transformation (from 3.11 to 0.25). For facial EMGs, the change scores (i.e., the differences between the baseline and the mean amplitude of the 6-s period after stimulus onset) were subjected to one-way MANOVAs with the factor of stimulus category. Corrugator supercilii muscle activity did not vary significantly, $F < 1$.

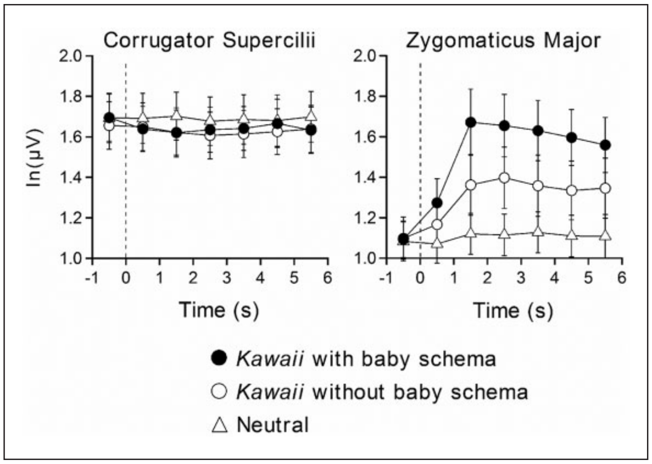

Figure 3. Time courses of facial muscle activities in response to the three stimulus categories.
Note. No significant differences were found regarding the corrugator supercilii muscles. Zygomaticus major muscle activities showed significant differences between *kawaii* with and without baby schema. Error bars indicate standard errors of the means.

Regarding zygomaticus major muscle activity, the effect of the category was significant, $F(2, 18) = 15.44$, $p < .001$, $\eta_p^2 = .632$. As shown in Figure 2, a multiple comparison of means revealed that, compared with the neutral pictures, both types of pictures induced greater zygomaticus major muscle activity, ts(19) = 5.34 and 2.89, $p < .001$ and $p = .009$ for *kawaii* with baby schema and *kawaii* without baby schema, respectively. Importantly, the response was significantly greater for the *kawaii* pictures with baby schema than for the *kawaii* pictures without baby schema, $t(19) = 4.65$, $p < .001$.

Figure 3 shows the time courses of facial EMGs without a baseline correction. A two-way MANOVA with the factors of stimulus category and time (seven 1-s periods) showed no significant effects on the corrugator supercilii muscles, $F < 1.34$, $p > .289$. Regarding the zygomaticus major muscles, the main effects of stimulus category and time and the interaction effect were significant, $F(2, 18) = 10.45$, $p = .001$, $\eta_p^2 = .537$; $F(6, 14) = 3.48$, $p = .026$, $\eta_p^2 = .599$; and $F(12, 8) = 5.96$, $p = .009$, $\eta_p^2 = .899$, respectively. A test of the simple main effect for each time point showed that, although no differences were found at the baseline period, $F < 1$, the categories differed as early as 0 to 1 s after stimulus onset, $F(2, 18) = 4.13$, $p = .033$, $\eta_p^2 = .315$. In this period, a significant difference was found only between the *kawaii* pictures with baby schema and the neutral pictures. After 1 s, the three categories differed significantly from one another. The data confirm the findings of the change score analysis. That is, compared with the neutral pictures, both types of *kawaii* pictures induced greater zygomaticus major muscle activity. Moreover, the activity was still greater for the *kawaii* pictures with baby schema than for the *kawaii* pictures without baby schema.

SCRs occurred rarely. The mean SCR frequencies were 18%, 12%, and 18% for the *kawaii* pictures with baby schema, the *kawaii* pictures without baby schema, and the neutral pictures, respectively. The mean amplitude (including no response trials) did not differ significantly among categories, $F(2, 18) = 1.34$, $p = .288$, $\eta_p^2 = .129$.

Picture-by-Picture Analysis

In the analysis of category differences described above, the mean *kawaii* score was numerically higher for the *kawaii* pictures with baby schema than for the *kawaii* pictures without baby schema. This slight, nonsignificant difference does not seem to cause the higher zygomaticus major muscle activity for the *kawaii* pictures with baby schema. To test this hypothesis, a picture-by-picture analysis was conducted. Figure 4 shows the scatterplot of the relationship between the *kawaii* score and each measure. The data are based on the mean values of 20 participants. For most measures, the distribution ranges of the five *kawaii* pictures with baby schema (solid circles) and the five *kawaii* pictures without baby schema (open circles) overlapped each other. However, this was not the case for zygomaticus major muscle activity. The difference between the two sets of five data points was significant in a nonparametric Mann–Whitney U test, $U = 2.00$, $p = .032$. This result supports that, although the *kawaii* score varied across pictures, the *kawaii* pictures with baby schema induced greater zygomaticus major muscle activity than the *kawaii* pictures without baby schema as a whole.

Figure 4 also shows the Spearman's rank correlation coefficients between *kawaii* rating and other measures. Significant correlations were obtained for subjective measures (*pleasant, unpleasant, infantile*, and *I want to approach*), viewing duration, and two facial EMG measures (zygomaticus major and corrugator supercilii muscles). Except for corrugator supercilii muscle activity, significant differences between stimulus categories were also obtained in the main analysis described above.

Discussion

The purpose of this exploratory study is to understand the commonalities and differences between the two types of *kawaii* stimuli with or without baby schema by comparing psychophysiological responses recorded while participants were viewing the pictures of each category. The *kawaii* pictures with baby schema induced more positive subjective feelings, greater zygomaticus major muscle activity, and a longer viewing duration than the neutral pictures. These results are consistent with the previous findings about psychophysiological responses to baby pictures (Bradley et al., 2001; Hildebrandt & Fitzgerald, 1978; Lang et al., 1993). The present study newly found that similar responses occurred also for *kawaii* pictures without baby schema. The difference between the presence and absence of baby schema

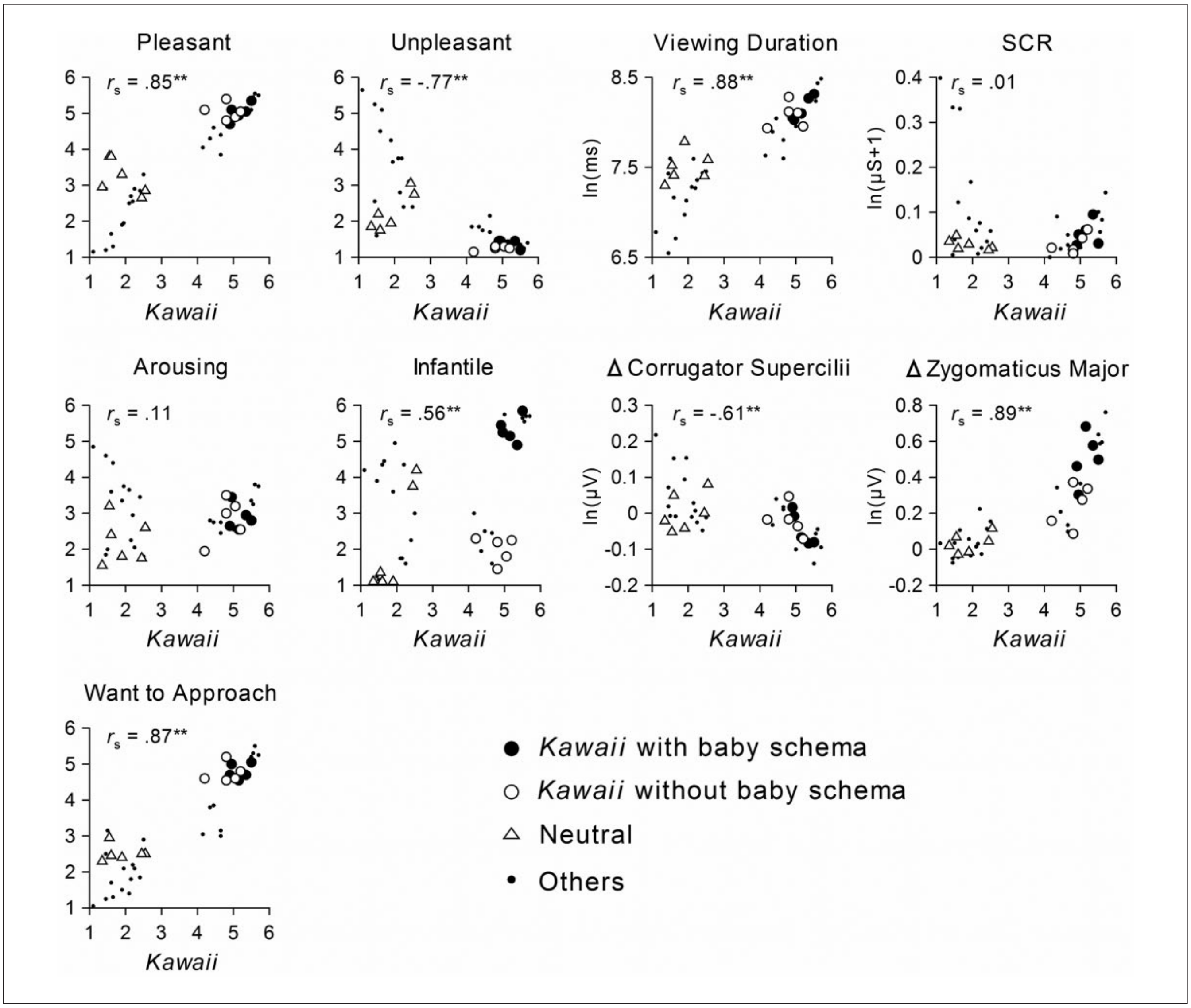

Figure 4. Scatterplots depicting the relationship between *kawaii* ratings (1 = *not at all* and 6 = *very much*) and respective measures.
Note. Spearman's rank correlation coefficients (r_s) were calculated from the 40 data points.
**$p < .01$.

appeared in the activity of the zygomaticus major muscles, which was greater for the *kawaii* pictures with baby schema.

Positive Feelings

Both types of *kawaii* pictures were associated with a higher score of pleasantness, a lower score of unpleasantness, and a stronger feeling related to approach motivation than the neutral pictures. These findings were confirmed by the picture-by-picture analysis. The *kawaii* score was positively correlated with the scores of pleasantness and desire to approach and negatively correlated with the score of unpleasantness.

However, the mean arousal scores of the *kawaii* pictures were not significantly higher than that of the neutral pictures. This result is consistent with the rare occurrence of SCRs to these pictures (less than 20%). Bohlin (1976) reported a similar frequency of SCRs when participants listened passively to tone stimuli that were presented at a random interval of 20 to 40 s. Therefore, the low occurrence rate of this study is not an exceptional case. An SCR is a measure of sympathetic nervous system activity and is known to be elicited by high-arousal affective pictures, regardless of their valence (Lang et al., 1993). The result of a subjective rating suggests that the rare occurrence of SCRs is mainly because the *kawaii* pictures were not arousing. Bradley et al. (2001) also showed that pictures depicting babies and their family ("Family" category) were rated as less arousing and induced smaller SCRs than other categories of high-arousal positive pictures (e.g., erotic couples). Shiota, Neufeld, Yeung, Moser, and Perea (2011) reported that viewing baby animals was associated with increased heart rate and increased respiratory rate. However, Sherman, Haidt, and Coan (2009) argued that heart rate and skin conductance level, which is another measure of sympathetic autonomic activity, did not consistently increase from the baseline when participants watched a slide show of baby animal pictures. These findings suggest that feelings of *kawaii* are associated with a low-to-moderate arousal state. In a review article on autonomic nervous system activity in emotion, Kreibig (2010) wrote that no conclusive statement could be made on the affection-related emotions because the amount of research was small. More studies are required to understand the autonomic responses underlying perceiving cute or *kawaii* objects.

Facial Expressions

Consistent with the well-established findings (Bradley et al., 2001; Hildebrandt & Fitzgerald, 1978; Lang et al., 1993), the pictures with baby schema activated the zygomaticus major muscles associated with smiling. In the present study, we newly found that *kawaii* stimuli without infantile features also elicited a smiling response, although its intensity was smaller than that of *kawaii* stimuli with baby schema. Bradley et al. (2001) suggested that not all stimuli with positive valence induce a smiling response. Specifically, family pictures depicting babies and children induced greater zygomaticus major muscle activity, whereas other pleasant picture categories, such as erotic couples, adventure, sports, and nature, did not. Smiling is a social behavior affected by the social context (Fridlund, 1991). Research has shown that laughter, which is often associated with big smiles, is highly contagious to multiple members of a group and has a function of fostering social bonds with them, more efficiently than one-to-one grooming (Dezecache & Dunbar, 2012; Provine, 2016). Given that smiling has a role in expressing nonhostility in the social context, it may enhance particularly for pictures that depict or are suggestive of affiliative social relations.

In the picture-by-picture analysis, a positive correlation was found between the *kawaii* score and the change in zygomaticus major muscle activity. More *kawaii* pictures elicited a greater zygomaticus major EMG response. This finding, however, does not mean that the EMG amplitude of the zygomaticus major muscles can predict the intensity of the subjective feelings of *kawaii*. Even when the subjective ratings of *kawaii* were equivalent, the presence of baby schema enhanced the facial EMG response. A previous study also showed that, although baby pictures elicited greater zygomaticus major muscle activity, the size of the facial EMG response did not correlate with the subjective ratings of cuteness (Hildebrandt & Fitzgerald, 1978; Nittono, 2011).

Although the two types of *kawaii* pictures differed in their infantility scores, infantility itself did not cause changes to the zygomaticus major muscle activity. Among 40 pictures, there were infantile but not *kawaii* stimuli (e.g., a premature baby who undergoes a medical procedure, children in horror movies), which correspond to the data points at the upper left corner of the scatterplot labeled *Infantile* in Figure 4. The zygomatic major muscle activity was low for these pictures (see the lower left corner in the scatterplot labeled Δ*zygomaticus major*). Therefore, *kawaii* is a key factor for eliciting greater zygomaticus major muscle activity.

Regarding the corrugator supercilii muscles, no significant differences were found among the three categories, whereas the picture-by-picture analysis showed a significant negative correlation between the change score of corrugator supercilii muscle activity and the *kawaii* score. The latter correlation is due to the pictures with negative valence that were not included in the analysis of the category differences. These pictures were associated with lower *kawaii* scores and higher corrugator supercilii responses. The amplitude of EMG over the corrugator supercilii muscles increased monotonically with the level of unpleasantness (Lang et al., 1993; Larsen et al., 2003). As shown in Figure 3, the activity of the corrugator supercilii muscles appears to be slightly lesser for the *kawaii* pictures than for the neutral pictures, although the difference was small and nonsignificant. In the present study, the level of corrugator supercilii muscle activity was not high at the baseline because participants were in a relaxed state. If they were in a stressful and negative state with elevated corrugator supercilii muscle activity, *kawaii* stimuli may serve to lower the activity level significantly.

Viewing Duration

Regardless of the presence or absence of baby schema, both types of *kawaii* pictures were viewed voluntarily for a longer period when they were presented for the second time. Pictures of babies who are rated to be cuter or that have a higher level of baby schema are viewed for a longer period in a free viewing task (Hildebrandt & Fitzgerald, 1978; Power, Hildebrandt, & Fitzgerald, 1982) and in a task in which participants can lengthen and shorten the duration of picture viewing by button presses (Parsons et al., 2011; Sprengelmeyer et al., 2013). The present study showed a similar increase in viewing duration for *kawaii* pictures without baby schema. This result is consistent with the subjective rating of desire to approach, which was higher for both types of *kawaii* pictures than for the neutral pictures, supporting the hypothesis that feelings of *kawaii* are associated with approach motivation. We used a passive viewing task according to a tradition of affective picture processing research (e.g., Lang et al., 1993). In a future study, this finding should be tested using an active button-press task described above that is conceptually more suitable for measuring the level of approach/avoidance motivation.

Limitations and Future Directions

There are several limitations in this exploratory study. First of all, the number of pictures presented were relatively small.

This was because we avoided boring participants with a longer sequence of pictures, which would reduce participants' general motivation. A further study with a larger number of pictures would be worthwhile. In addition, the present study used a post hoc selection of stimulus sets. This protocol is useful to control variables within the group of participants actually analyzed. However, to increase the generalizability of the results, it may be better to predefine the picture sets first by a preliminarily survey with a larger sample size.

Second, only women participated in the study. Women are generally more sensitive to and interested in babies than men (Berman, 1980; Hahn et al., 2013; Lehmann et al., 2013; Lobmaier et al., 2010; Sprengelmeyer et al., 2013; Sprengelmeyer et al., 2009), although the motivation to see cute babies may not differ between men and women (Parsons et al., 2011). One question is whether these gender differences exist for *kawaii* stimuli without baby schema. Because women are more interested not only in babies but also in *kawaii* things without baby schema (Nittono, 2016), some gender differences may exist. However, these differences are probably more influenced by culture than by biology.

Third, this study did not care for individual differences in *kawaii* responses. A previous research study suggests that people with high empathy characteristics showed greater responses to baby schema (Lehmann et al., 2013). Kanai and Nittono (2014) showed that the relationship between empathy and feelings of *kawaii* was observed not only for babies but also for inanimate *kawaii* objects, such as clothes and accessories, in which living creatures were not used as a motif. In future studies, it is worth investigating how other personality variables related to empathy, such as autism and psychopathy, are associated with responses to baby schema and responses to *kawaii* stimuli without baby schema.

Fourth, further research must examine whether the presence or absence of baby schema in *kawaii* pictures affects other types of behavior and physiological measures. It has been shown that viewing *kawaii* pictures with baby schema promotes careful behavior and narrows the focus of attention (Nittono, Fukushima, Yano, & Moriya, 2012; Sherman et al., 2009; Sherman, Haidt, Iyer, & Coan, 2013). It is interesting to test whether this effect also occurs after viewing *kawaii* stimuli without baby schema. It will offer an answer to the question of whether this effect is due to baby schema or due to a positive emotion with a strong approach motivation.

Conclusion

Traditionally, cuteness is regarded as synonymous with infant physical attractiveness. The Japanese word *kawaii* is used to describe babies and infantile features, but it is also used for noninfantile objects. In this exploratory study, we focused on the latter type of *kawaii* without baby schema. Both types of *kawaii* pictures induced a positive emotion with a strong approach motivation (indexed by subjective rating and viewing duration) and a smiling response as compared with neutral pictures, although the smiling response was larger for the pictures with baby schema than for the pictures without baby schema. These findings suggest that the word *kawaii* used in present-day Japan expresses positive feelings that are more generic than infant attractiveness and that are associated with a motivation to approach a preferable object. More than 70 years after Lorenz's (1943) proposal of baby schema, recent research has just begun to show that the feelings of cuteness are not directly associated with protection and nurturance (Nenkov & Scott, 2014; Sherman & Haidt, 2011). The present study suggests that the concept of *kawaii* (and potentially also the concept of cuteness) would be broader than the responses to baby schema. Studying about *kawaii* can be useful for developing a more elaborative model of the universal feelings of cuteness.

Authors' Note

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Declaration of Conflicting Interests

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