Isn't It Cute: *An Evolutionary Perspective of Baby-Schema Effects in Visual Product Designs*

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Through applying an evolutionary approach, we examined affective consumer responses to facial features in product designs. Previous studies have suggested that consumers might perceive the fronts of cars similarly to how they perceive human faces, but how consumers respond on an affective level to evolutionarily significant features when they are part of artifacts such as product designs has not been thoroughly studied. Therefore, we studied affective responses to features of an important stimulus that is known to elicit affect and approach behavior: the baby schema. We tested whether the affective responses to this stimulus were generalized to product designs, and how stable these generalized responses were over repeated exposures. We manipulated car fronts - and faces as controls - in accordance with the baby schema (e.g., by enlarging the headlights/eyes). Combining facial electromyography with cuteness ratings to assess innate affective responses, we found that our participants (n = 57) showed more positive affective responses to the babyfaced car fronts than to the original stimuli, and that the effect of the baby-schema features on positive affect was stable over two repeated exposures, thus did not show effects of fast habituation. These results confirm that consumers' affective responses to visual product designs are affected by evolutionarily-implemented features.

Keywords – Affective Responses, Cuteness Perception, Evolutionary Psychology, Face-like Product Design, Facial EMG.

Relevance to Design Practice – Designers often use intuitive approaches about what appeals to consumer affect and emotions. We provide empirical support on which specific features appeal to the cute appearance of a design, and how to systematically trigger positive (and presumably innate) affective responses in consumers.

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Introduction

The emotional value of products is deemed highly important by design researchers and practitioners in distinguishing a product from technically equivalent competitors (e.g., Chitturi, 2009; Desmet, Overbeeke, & Tax, 2001). Creating anthropomorphic features is one strategy in product design practice to accomplish emotional designs. This is reflected, for example, by a car designer's concern for the "face" of a car (Welsh, 2006). Other examples can be seen in the creation of cute, babyish-appearing product designs, such as those of the Volkswagen Beetle and the Mini Cooper (Marcus, 2002; Patton, 1998). Through using such appearances, product designers make use of a deeply embedded human trait already known to psychologists and anthropologists where, due to the evolutionary significance of human features, perceivers are highly sensitive to them and attracted to them (Coss, 2003; Guthrie, 1993). However, the marketers' and designers' assumptions on the visual features which attract consumers' emotions may have been based rather intuitively on such evolutionary principles (e.g., Colarelli & Dettman, 2003). So far, it has not been studied systematically in design research whether consumers' affective responses to anthropomorphic product designs can really be explained by innate psychological mechanisms.

In the present research, we put an evolutionary approach to the test by studying one type of innate perceptual mechanism: the detection of the baby schema (Lorenz, 1943) and, more interestingly, the nature of the resulting affective responses. Our research pursued two main goals. First, we wanted to take a first step in exploring the explanatory power of the evolutionary psychology framework in the area of product design by studying whether innate affective responses to physical features of the baby schema are generalized to product designs. Using such a framework bears important differences from the approaches previously used in product design research to study affective responses to design. Differing from explorative approaches (e.g., Blijlevens, Creusen, & Schoormans, 2009; Chang & Wu, 2007), using this framework allows for the creation of theory-driven predictions about the relationship between specific design features and consumer responses. Further, evolutionarily determined affect might be directly triggered by a product's physical design features when a consumer sees a product; hence, responses to product design

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are not necessarily mediated by cognitive appraisal processes (cf., Desmet, 2003). Therefore, relating to our goal of exploring the efficacy of using an evolutionary approach to design, we extended the existing research on consumer perceptions of anthropomorphic products by examining the direct impact of face-like designs on positive consumer affect. As a second goal of our research, we hoped to demonstrate the efficiency of a non-verbal method to measure product-related affect reliably by employing facial electromyography (EMG).

Throughout the rest of this paper, we will use the terms *affect* or *affective response* to refer to rapidly formed impressions of a product's valence as positive or negative, triggered by the product's appearance per se (Bar & Neta, 2006; Zajonc, 1980). These responses need to be differentiated from discrete emotional responses to products such as pride or excitement, which are supposed to result from the *cognitive interpretation* of a product as positive or negative (Desmet, 2003; Sander, Grandjean, & Scherer, 2005), but which were not in the scope of the present paper.

An Evolutionary Psychology Approach to Design and Affect

Only recently, consumer research has increasingly acknowledged that "consumers are biological and Darwinian beings" (Saad, 2008, p. 426; Durante, Griskevicius, Hill, Perilloux, & Li, 2010; Griskevicius, Shiota, & Nowlis, 2010; Saad & Gill, 2000). According to the general framework of evolutionary psychology, all human behavior relies, to a certain degree, on innate perceptual, cognitive, affective and/or motivational mechanisms that have evolved through natural selection as adaptations to specific ancestral conditions. These adaptive mechanisms are considered functional as they increased the chance of the human species to survive and reproduce, and they still affect domains of modern everyday life, such as mating (Buss, 1994), food choice (Rozin, 1976), and even aesthetic preferences (Voland & Grammer, 2003). In the next sections, before addressing innate affective responses to babies as an important example for such an evolutionary adaptation, we briefly summarize the existing research on anthropomorphic consumer perceptions which was the starting point of our project.

Anthropomorphic Shapes in Product Designs

Although there are many examples for human-like designed products (for an overview see DiSalvo & Gemperle, 2003), systematic research addressing such anthropomorphic product forms and the related consumer reactions is still scarce, but increasing (Aggarwal & McGill, 2007; Chandler & Schwarz, 2010; Landwehr, McGill, & Herrmann, 2011; Miesler, Landwehr, Herrmann, & McGill, 2010). Among the different anthropomorphic features, researchers have mainly focused on face-like shapes because these are supposed to have a particularly strong effect on consumers. Perceivers are highly sensitive to human faces, because they can infer a lot of information from facial features and expressions in a glance, such as a person's age, gender, personality traits, or emotional states (Willis & Todorov, 2006).

Previous research has mainly addressed the cognitive mechanisms underlying perceptions (i.e., detection of facial features; product-related inferences). In particular, from studying the perception of face-like forms in cars, some authors have suggested that consumers process a car's front-end similarly to processing a human face (Landwehr et al., 2011; Miesler et al., 2010; Windhager et al., 2010; Windhager et al., 2008; see also Pittenger & Shaw, 1975). Thus, Windhager et al. (2010) investigated people's eye movement patterns when they compared car fronts with human faces, and found that a car's headlights are perceived correspondingly to the eyes, the grille correspondingly to the nose, and the air intake or the grille correspondingly to the mouth. In another study, Windhager et al. (2008) showed that people drew the same inferences from car fronts as from human faces when participants rated the cars on evaluative dimensions such as male-female, friendly-hostile, and child-adult. Similarly, Landwehr et al. (2011) recently demonstrated that consumers' explicit judgments concerning a product's friendly or aggressive appearance were affected by face-like designed features.

Consumers, then, detect anthropomorphic (i.e., face-like) shapes in product designs easily, and they might use their knowledge about humans to evaluate the appearance (e.g., as friendly, aggressive) of such designs (cf., Epley, Waytz, & Cacioppo, 2007). However, in the context of affective responses to design, such cognitive effects would not automatically imply that face-like shapes also produce product-related affect or elicit corresponding emotions. Even though the affective value of evolutionarily significant shapes such as faces is well known (Ekman, 1982; Ellis & Young, 1998), their direct link to affective responses has been rather neglected in product design research.

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Rapidly occurring and subtle product impressions can have a stronger effect on consumer behavior than cognitive evaluation processes (Pham, 1998; Schwarz & Clore, 1988; Winkielman, Berridge, & Wilbarger, 2005). However, even when positive affect toward anthropomorphic designs was addressed (Aggarwal & McGill, 2007), the increased positive affect was theorized as a by-product of a cognitive process (i.e., successful schema congruity) rather than being directly triggered by the product's physical appearance. Though Landwehr et al. (2011) recently examined affective responses, which they supposed to be directly triggered by face-like design features, they used self-report measures. Therefore, the innate nature of the affective responses could not be accounted for by their method (i.e., rapid and presumably automatic elicitation), as self-report measures of affective or emotional responses are generally biased by conscious thoughts (e.g., Poels & Dewitte, 2006). Therefore, building on evolutionarily explained responses to babies, we posit that detecting facial features in product designs rapidly triggers the adequate affective responses in consumers. We elaborate on this assertion hereafter.

The Baby Schema

Faces have a high potential for inducing affective or emotional responses in humans. The valence of facial features, which signals the perceiver to initiate an adaptive behaviour in terms of approach or avoidance, is processed especially automatically and rapidly (Dimberg & Thunberg, 1998; Dimberg, Thunberg, & Elmehed, 2000). From an evolutionary perspective, one important behavior for human survival is the need for nurturing and caretaking of babies. The ethologist Lorenz (1943) observed that babies elicit strong positive responses in humans as expressed, for example, in approach behaviors such as spontaneous smiling and verbalizations (e.g., "oh, how cute!"; Zebrowitz, 1997, p. 65). Lorenz proposed that it is the baby schema, the typical physical appearance of babies of all species (e.g., a round face, large eyes, a small nose, a high forehead), that serves as a visual key stimulus to trigger positive affect in people, and that this promotes the related behavioral responses. In accordance with Lorenz' assumptions, behavioral studies have shown that the presence of baby-schema features in infants is positively correlated with perceived infant cuteness (Hildebrandt & Fitzgerald, 1978; Glocker et al., 2009; Lobmaier, Sprengelmeyer, Wiffen, & Perrett, 2010; Sprengelmeyer et al., 2009), adults' motivation for caretaking (Glocker et al., 2009), and behavioral tenderness (Sherman, Haidt, & Coan, 2009). Moreover, neuropsychological studies have found that brain areas that are associated with the anticipation of reward (Glocker et al., 2009) or those that are involved in decoding a stimulus' affective value (Nitschke et al., 2004; Zebrowitz, Luevano, Bronstad, & Aharon, 2007) show an increased activation in the presence of cute infant faces. Besides the evidence for the baby schema's high affective value, Brosch, Sander, and Scherer (2007) showed that people can differentiate between infant and adult faces in less than one second, supporting the assumption that facial features of the baby schema are processed rapidly and presumably automatically.

Due to the importance of the baby schema for human survival, such innate affective responses might also occur in respect to artificial objects when these mimic features of the baby schema. Therefore, to address affective responses to face-like product designs, our first research question was: Are consumer responses to babies so hard-wired that, as a consequence, features of a baby schema elicit innate positive affective responses in consumers even when they are transferred to the visual design of products such as cars? It has been already shown that humans are not only sensitive to baby-schema features in infant faces, but that they also respond positively to infant animals (Sanefuji, Ohgami, & Hashiya, 2007), cute cartoon characters or dolls (Jacob, Rodenhauser, & Markert, 1987), and babyfaced human faces of various ages (Berry & Zebrowitz, 1985; Gorn, Jiang, & Johar, 2008; Livingston & Pearce, 2009; Zebrowitz & Montepare, 1992; Zebrowitz, Fellous, Mignault, & Andreolletti, 2003). However, it has not been investigated before whether such a generalization of the evolutionarily adaptive response to baby features also occurs when consumers face product designs, which do not generally have the same evolutionary relevance, and are not a class of biological objects.

It is essential for companies that their products attract consumers not only at first sight, but also over the long run. Therefore, we further investigated whether affective responses to features of a baby schema are relatively stable over time, and do not habituate. As the meaning of habituation can be defined as filtering out recurring stimuli that have no significance for survival (e.g., Eisenstein, Eisenstein, & Smith, 2001), stimuli which are highly significant for human survival such as emotional faces or the baby schema should be less prone to habituation effects. For example, Dimberg and Thunberg (1998) found that rapid affective responses to emotional expressive faces did not change over repeated exposures. In case of the baby schema, such a potential lack of habituation is essential for infant survival, as it guarantees long-term parental care. As it is already known that consumer responses to general design features such as visual complexity (Cox & Cox, 1988, 2002) are quite susceptible to repeated exposures, stable affective responses would make evolutionarily significant shapes special. For example, the liking for visually simple designed products decreases quickly with repeated exposure, due to tedium, whereas the liking for complex designs increases with repeated exposure due to familiarization (Bornstein, 1989; Cox & Cox, 2002), but might also decrease after a large number of repetitions (Berlyne, 1970; Tinio & Leder, 2009). Hence, we examined as a further research question whether features of the baby schema were an effective tool to produce relatively stable affective responses to product designs.

Non-verbal Assessment of Innate Affective Responses: Facial Electromyography

To address the two research questions, we investigated consumer affect to babyfaced product designs beyond explicit self-reports by an implicit psycho-physiological method (cf., Jenkins, Brown, & Rutterford, 2009; Wang & Minor 2008), employing facial

EMG. The basic idea of facial EMG is that affective responses to objects also manifest in specific facial expressions such as smiling or frowning (Ekman, 1982; Ekman, Friesen, & Ancoli, 1980). Facial EMG was the method of choice for two reasons. First, compared to affective responses which are elicited by emotionally strong cues such as angry faces, we expected the responses to product designs to be mild and subtle (cf., Desmet, Hekkert, & Jacobs, 2000), and therefore not to be accompanied by overt facial reactions. In contrast to approaches which observe and classify overt expressions (e.g., Facial Activation Coding System, Ekman & Friesen, 1975), facial EMG reliably captures changes in positive and negative affective states even when overt facial expressions are absent (Cacioppo, Petty, Losch, & Kim, 1986; Dimberg et al., 2000; Winkielman & Cacioppo, 2001). Second, we expected the affective responses to occur very quickly as an indication of their innate (and presumably automatic) nature. Thus, the participants should show changes in muscle activation in the first seconds of exposure to a design, and even before they start to develop a deliberate judgment about the design. Compared to self-report measures (e.g., Self-Assessment Manikin SAM, Lang, 1985; cf., Landwehr et al., 2011), facial EMG allowed for an unbiased and even pre-cognitive assessment of the affective responses.

Usually facial EMG employs two muscles, the *corrugator supercilii* muscle, which furrows the brow (the "frowning muscle") and is mainly related to negative affective states; and the *zygomaticus major* muscle, which raises the corners of the mouth (the "smiling muscle") and is mainly related to positive affective states. For our purpose, the latter muscle was essential. However, some authors demonstrated that positive affective states are also indicated by a decrease of *corrugator supercilii* activity (Dimberg, 1990). Thus, with regard to our first research question, we hypothesized that product designs that were manipulated in accordance with the baby schema rapidly elicit a larger activation of *zygomaticus major* and a lower activation of *corrugator supercilii* compared to the original, less babyfaced stimulus versions (H1). If babyfaceness is the cause of such effects, we should find the same effects with faces manipulated like the product designs. Therefore, faces served as control group to test for the internal validity of the results. With regard to our second research question, comparing repetition effects between babyfaced and less-babyfaced stimuli, we hypothesized that the intensity of the facial muscular activation triggered by product designs (faces) with baby-schema features should be less susceptible to repeated exposure (i.e., no habituation) than the activation elicited by the original, less-babyfaced stimulus versions (H2).

Finally, although our study's focus was on affective responses triggered by babyfaceness, we have to make a brief remark on the relationship between babyfaceness and attractiveness. In particular, two aspects of this relationship affected our main study's method. First, both dimensions are evolutionary relevant (e.g., an attractive face signals health and good genes), so a stimulus' degree of attractiveness is also processed rapidly (Olson & Marshuetz, 2005), and can also trigger positive affect which manifests in facial muscle activation (Gerger, Leder, Tinio, & Schacht, 2011). Second, features of the baby schema might increase perceived attractiveness; however, the relationship between both dimensions is far from clear and correlated at best (Berry, 1991; Zebrowitz, 1997; Zebrowitz et al., 2007), so that babyfaceness is a possible, but not a necessary key to attractiveness. To disentangle affective responses due to babyfaceness from those due to attractiveness, we included attractiveness measures as a kind of control condition.

Methods

In order to select the appropriate baby-schema (feature-size) manipulations to be applied to the two object categories (car fronts and faces), and to check if the manipulations produced changes in perceived cuteness in the two object classes that were comparable in size, systematic pretests were conducted. In the main study, beyond explicit verbal ratings, facial EMG was employed to assess subtle and rapid affective responses to the stimuli to test the hypotheses.

Pretest

Participants

Thirty-five students took part in the pretest. One group of participants rated pictures of cars (n = 19; M_{age} = 23 yrs, SD_{age} = 3 yrs; 74% females), and another group rated pictures of faces (n = 16; M_{age} = 27 yrs, SD_{age} = 6 yrs; 75% females) for cuteness on a 7-point Likert scale (1 = "not cute at all" to 7 = "very cute").

Stimuli Construction

Grayscale pictures of 16 cars shown in frontal view served as stimuli for the product design category (picture size: 512×512 pixels). To ensure that the effects were independent of a particular brand or segment, brand logos were eliminated, and the car picture set comprised nine cars from the compact car segment (e.g., Fiat, Mini), and seven from the middle-class segment (e.g., Mercedes, BMW). The face picture set consisted of grayscale pictures of 16 faces with neutral emotional expressions (eight male and eight female faces; picture size: 370×555 pixels). The pictures were taken from the Vienna Face Database, which contains standardized pictures of male and female students with an age range from 18 to 25 years.

For each picture, a babyfaced version was created by a professional graphic designer using Adobe Photoshop. The relative sizes of three selected localized features (the headlights/eyes, the middle grille/nose, and the air intake/mouth) were manipulated. The features and the appropriate size manipulations were selected in accordance with literature on physical cues characterizing the baby schema (Zebrowitz, 1997). Furthermore, the selected facial features clearly corresponded to the features of a car front (e.g., the car's headlights as human eyes), as in Windhager et al. (2010).

For each of the 16 original cars, a babyfaced version was created by enlarging the headlights by 20% (because babies have proportionally large eyes), shrinking the middle grille by 20% (because babies have proportionally small noses), and decreasing the width of the air intake by 20%, while simultaneously increasing its height by 20% (because babies have small mouths but relatively thicker lips than adults). Other authors have also employed such feature-size manipulations in a range of 10-20% (e.g., Keating, Randall, Kendrick, & Gutshall, 2003). Size manipulations in the face stimuli were set to 10% because a pretest where 19 participants (74% females) were exposed to size manipulations of 20% revealed that larger size manipulations created unnatural face versions. The faces' relational characteristics (e.g., distance between the nose and upper lip) were changed as little as possible (for examples, see Figure 1).

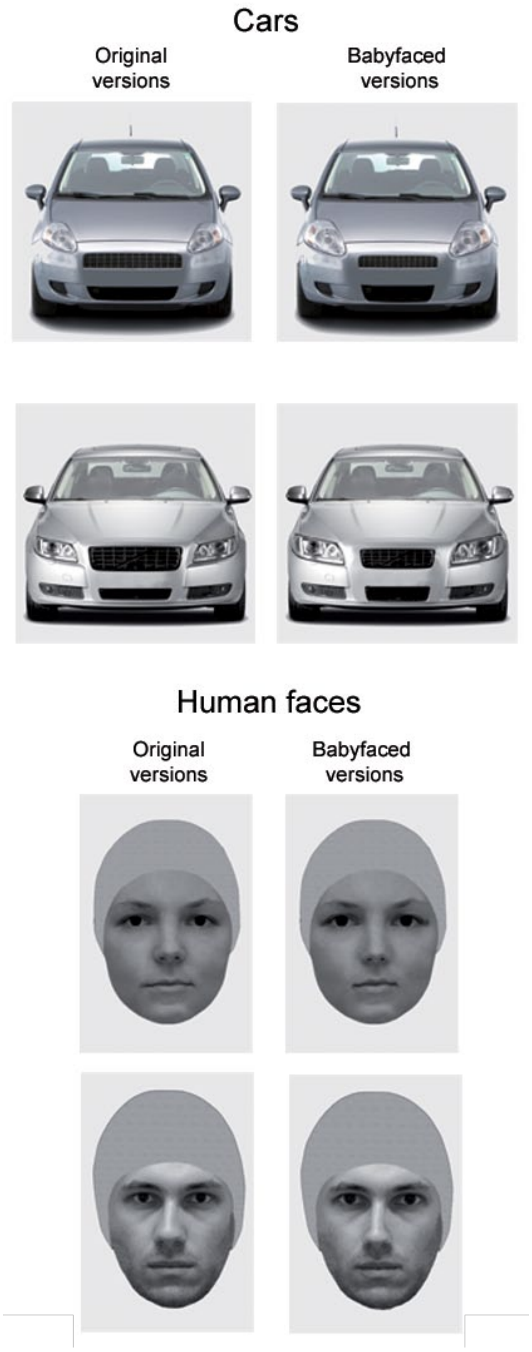

Figure 1. Examples of non-manipulated (original) and manipulated (babyfaced) pictures of cars and faces.

The effects on perceived cuteness were comparable for cars and faces, although the size manipulations differed in quantity between the two object categories, as was confirmed in a 2 (feature size: original versus babyfaced) × 2 (object category: car versus face) ANOVA on the average rated cuteness of the cars and faces. We found a significant main effect of feature size, F (1, 30) = 107.08, $p < .001$, $\eta_p^2 = 0.78$, and the babyfaced car fronts and faces ($M = 3.85$, $SD = 1.13$) were perceived as cuter than the original stimuli ($M = 3.33$, $SD = 1.09$). Moreover, we found no significant main effect of object category, and no interaction of feature size with object category (both F-values < 1). Therefore, although the applied feature-size manipulations were different in quantity, the effects of the manipulation on perceived cuteness were comparable between the two object categories. This warranted comparing the affective responses to features of a baby schema in products and faces, as examined in the main study.

Moreover, an additional pretest (n = 25; 56% females) ensured that the feature-size manipulation was not confounded with the perceived visual complexity of the car designs ($M_{babyfaced} = 3.54$, $SD_{babyfaced} = 1.08$; $M_{original} = 3.56$, $SD_{original} = 1.1$; F (1, 24) < 1), which was important to test the habituation hypothesis.

Main Study: Facial EMG

Participants

Fifty-seven undergraduate students participated in the facial EMG study for partial course credit. Data of four persons had to be excluded in both the car and face groups due to inappropriate behavior during the experimental session (e.g., sleepiness), and/or too many movement artifacts (e.g., chewing, and yawning). Thus, the final sample consisted of 28 car group participants ($M_{age} = 22$ yrs, $SD_{age} = 2$ yrs; 61% females), and 21 face group participants ($M_{age} = 21$ yrs, $SD_{age} = 2$ yrs; 67% females).

Design and Stimuli

The study design was a 2 (feature size: original versus babyfaced) × 2 (repeated exposure: first exposure versus second exposure) × 2 (object category: car fronts versus faces) mixed design with repeated measurements on the first two factors and object category as the between participants factor. The object categories were varied between participants to prevent participants from reflecting on the possible relationship between car fronts and faces. Overall, the stimulus set comprised a total of 64 pictures, 32 car and 32 face pictures, according to the pretest. All stimuli were presented in the center of a 30-inch monitor on a medium grey background (RGB 220, 220, 220) to reduce eyestrain from the computer monitor.

Procedure

Participants were tested individually. Before the experiment, the participants were briefed regarding the EMG electrode attachment procedure, and were told that skin conductance reactions would be recorded to reduce demand characteristics (Dimberg & Thunberg, 1998; Weyers, Mühlberger, Hefele, & Pauli, 2006). Then, the skin of the muscle sites was cleaned, and the electrodes were attached. Participants were seated 1 m in front of the monitor. They were given brief instructions on the overall procedure of the study, and were informed that they would be filmed with a video camera attached to the top of the computer monitor during the whole session for safety reasons (e.g., in the case that an electrode detaches). The experimenter observed the experiment on a monitor in a separate room.

Stimulus pictures were presented in a block design containing two consecutive evaluation blocks (Figure 2). In the first block, participants rated the stimuli with regard to attractiveness; in the second block, they rated the same stimuli with regard to cuteness. If we had assessed muscle activation in a mere viewing task (without ratings), affective responses to babyfaceness could have interfered with affective responses to attractiveness. Therefore, to be on the safe side and to increase internal validity, we included explicit ratings to ensure affective responses in the context of cuteness perception (and attractiveness perception as control, respectively). Such explicit evaluations do not interfere with automatic psycho-physiological responses, such as those assessed by facial EMG (cf., Lang, Greenwald, Bradley, & Hamm, 1993). Between the two evaluation blocks, participants took a short break of five to ten minutes. To conceal the study's aim (i.e., babyfaceness), participants always completed the attractiveness block first and the cuteness block afterwards. Following the two evaluation blocks, the participants in the car group were exposed to a third block where they rated the original version of each car with regard to familiarity. As we expected the familiarity with the designs to vary considerably between different individuals, familiarity was rated post-experimentally by the same participants (and not by a separate group). However, since including the participants' familiarity ratings (M_{sample} = 4.07, SD_{sample} = 0.68) as a covariate in our analyses revealed that familiarity with the car designs had no effect on our main results, we will not discuss this variable later in the article. All ratings were made on 7-point-Likert scales with 1 = "not attractive/ not cute/ (not familiar)" and 7 = "very attractive/ cute/ (familiar)." Each evaluation block began with three practice trials, which were not used in the subsequent test trials. Within an evaluation block, each of the 32 stimulus pictures (cars or faces only) was presented twice to examine habituation effects (see Figure 2 "block design"). Thus, the participants saw at first all 32 stimuli in random order (T1; the 16 original plus the 16 babyfaced stimuli), before the stimuli were newly randomized and presented a second time (T2). The original and the babyfaced version of the same stimulus were never presented in a row. Each trial started with a fixation cross (3 s), followed by the stimulus (5 s), then the rating scale appeared in the middle of the screen, and the participants made their response by pressing a button (see Figure 2 "trial design"). Each stimulus was presented for five seconds to track when and how fast the facial muscular responses occurred. Before the next trial begun, there was an inter-trial interval of 4 s. At the end of the experimental session, the participants' gender and age were assessed, and they were debriefed about what they thought the goal of the study was and why electrodes were attached. The whole procedure took approximately 50-60 minutes.

Facial EMG Recording and Data Pre-processing

Facial EMG was recorded over the *zygomaticus major* and the *corrugator supercilii* muscle sites of the left side of the face (Fridlund & Cacioppo, 1986, p. 571). One pair of silver/silver chloride bipolar surface electrodes (4 mm diameter/7 mm housings) was placed over each muscle site. The ground electrode was located on the bone behind the right ear. Impedances of all electrodes were reduced to less than 10 kΩ. The EMG raw signals were recorded with a TMS International Portilab 20 channel amplifier at a sampling frequency of 2,048 Hz. Raw data were filtered offline with a 20 Hz high pass filter and a 50 Hz notch filter. Moreover, raw data were screened offline for movement artifacts by crosschecking salient EMG signals with the video recordings. Thus, trials containing movement artifacts (e.g., biting, chewing, coughing, and speaking) were excluded from further analyses.

Raw EMG signals represented changes in muscle activation in microvolts (μV) as a function of time. To facilitate data processing, several further data-processing steps were performed offline. Thus, raw data were full-wave rectified, and integrated

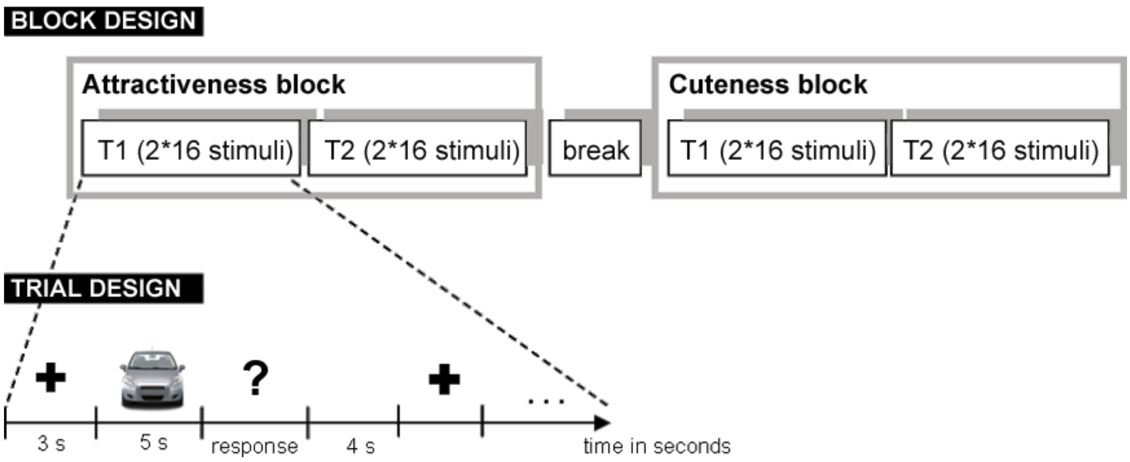

Figure 2. Simplified flowchart depicting block and trial design of the main study (facial EMG was measured continuously).

with a time constant of 125 ms (Topolinski, Likowski, Weyers, & Strack, 2009; Weyers et al., 2006). Finally, data were standardized to *z*-scores within participants and muscle sites (Winkielman & Cacioppo, 2001). EMG activations during the five seconds of stimulus presentation were averaged in five intervals of 1 second and expressed in terms of change scores relative to a pre-stimulus baseline. The average EMG activity during the last second of the 4-seconds fixation cross before the stimulus was presented provided baseline values. For statistical comparisons, EMG data were averaged over the 16 stimulus-presentation trials in each of the two feature-size conditions (original versus babyfaced), separately for the first (T1) and second (T2) stimulus exposure within a block. All offline data processing steps were computed in Matlab 7.1 using EEGLAB toolbox (Delorme & Makeig, 2004). Statistical analyses were conducted with SPSS 18.

Results

The study's main goal was to investigate whether features of the baby schema produced positive affective responses to car fronts and faces, and how these affective responses changed over repeated exposures. For both hypotheses, we present the results separately for car fronts and faces. The facial EMG responses evoked during cuteness evaluations were our primary interest, but at the end of the results section, we also briefly present results from the attractiveness-evaluation block. Data of female and male participants were aggregated in all analyses, as we did not find any effect of gender on our main results.

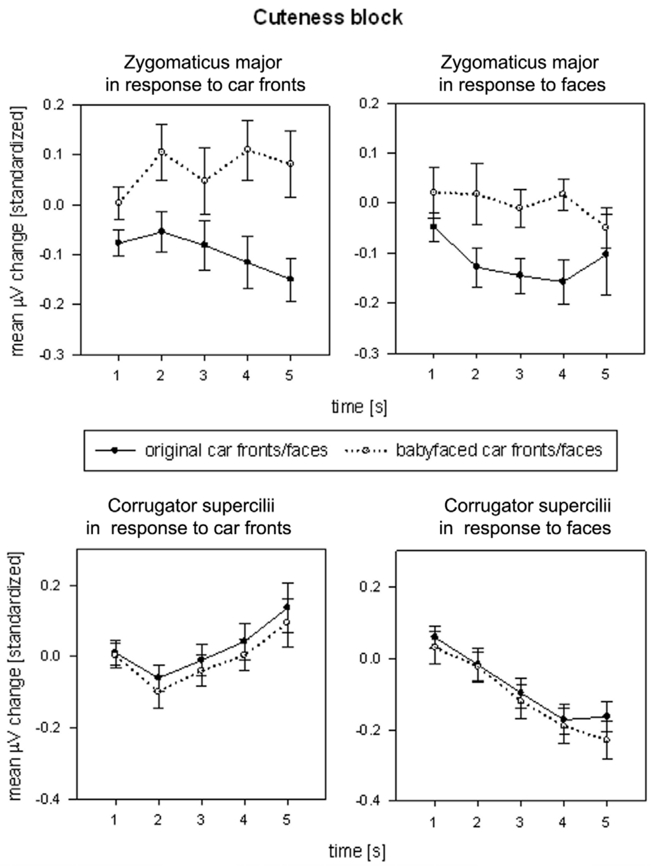

Figure 3. Average muscle activation profiles of *zygomaticus major* and *corrugator supercilii* in response to cars and faces (T1 only).

Manipulation Check Based on the Self-Reported Cuteness Ratings

Before analyzing the implicit affective responses assessed by facial EMG, we checked whether the feature-size manipulation was successful with regard to the cuteness ratings assessed during the facial EMG recordings. In both object categories, the behavioral results were as expected. The babyfaced car fronts were perceived as cuter than the original ones (averaged over T1 and T2: $M_{babyfaced} = 3.75$, $SD_{babyfaced} = 0.\ 51$ versus $M_{original} = 3.49$, $SD_{original} = 0.44$; $t\ (27) = 3.87$, $p = .001$, Cohen's $d = 0.54$). The same held for the face stimuli group: participants perceived the babyfaced faces as cuter than the original faces ($M_{babyfaced} = 3.88$, $SD_{babyfaced} = 0.73$ versus $M_{original} = 3.53$, $SD_{original} = 0.66$; $t\ (20) = 7.26$, $p < .001$, Cohen's $d = 0.51$).

Facial Muscular Responses during Cuteness Evaluation (H1)

To test if babyfaced car fronts and faces elicited larger positive affective responses than the original stimuli, we submitted the participants' facial EMG data to four 2 (feature size: original versus babyfaced) × 5 (time interval: seconds 1 to 5 after stimulus onset) repeated measurement ANOVAs, separately for the two muscle sites and the two object categories. To analyze the initial responses to a stimulus within a block, only responses at T1 (cf., Figure 2) were analyzed. Potential differences between the first and second exposure within the block are reported in the habituation passage below. Facial EMG data for car fronts and faces are plotted in Figure 3 as a function of the time interval, with separate panels for activity over the *zygomaticus major* and *corrugator supercilii*.

Car Fronts

The overall *zygomaticus major* activity was larger for babyfaced car fronts ($M = 0.07$, $SD = 0.23$) than for the original cars ($M = -.10$, $SD = 0.18$), during the five seconds of first stimulus exposure, $F\ (1, 27) = 8.34$, $p = .008$, $\eta_p^2 = 0.24$. The main effect of the time interval was not significant ($F\ (1, 27) < 1$), nor was the interaction of feature size with time interval ($F\ (2.58, 69.75) = 2.23$, $p = .101$, $\eta_p^2 = 0.08$). Separate analyses for each of the five time intervals revealed that babyfaced car fronts elicited a significantly larger *zygomaticus major* activation than the original cars in the first second after stimulus onset (1st second: $F\ (1, 27) = 4.33$, $p = .047$, $\eta_p^2 = 0.14$; 2nd second: $F\ (1, 27) = 7.79$, $p = .01$, $\eta_p^2 = 0.22$; 3rd second: $F\ (1, 27) = 2.84$, $p = .104$, $\eta_p^2 = 0.10$; 4th second: $F\ (1, 27) = 8.94$, $p = .006$, $\eta_p^2 = 0.25$; and 5th second: $F\ (1, 27) = 7.10$, $p = .013$, $\eta_p^2 = 0.21$). The analyses of the activity over the *corrugator supercilii* data revealed no main effect of feature size ($F\ (1, 27) <$

1), a main effect of time interval (F (1.72, 46.45) = 4.72, p = .018; η_p^2 = 0.15), and no interaction of feature size with time interval (F (1, 27) < 1). *Corrugator supercilii* activity increased as a function of time interval.

Faces

Also for faces, the overall *zygomaticus major* activity was larger for babyfaced faces (M = -0.01, SD = 0.13) than for the original faces (M = -0.08, SD = 0.24), F (1, 20) = 6.88, p = .016, η_p^2 = 0.26. Neither the main effect of time interval (F (1, 20) < 1) nor the interaction between feature size and time interval were statistically significant (F (2.38, 47.52) = 1.01, p > .3, η_p^2 = 0.05). Separate analyses for each time interval showed that the babyfaced versions of the faces elicited a significantly (or marginally, respectively) larger *zygomaticus major* activation than the original faces in three (the intermediate ones) of the five time intervals (1st second: F (1, 20) = 1.58, p > .2, η_p^2 = 0.07; 2nd second: F (1, 20) = 3.89, p = .063, η_p^2 = 0.16; 3rd second: F (1, 20) = 9.33, p = .006, η_p^2 = 0.32; 4th second: F (1, 20) = 8.22, p = .010, η_p^2 = 0.29; 5th second: F (1, 20) < 1). Moreover, the ANOVA revealed a main effect of time interval on *corrugator supercilii* activity (F (2.44, 48.77) = 13.94, p < .001; η_p^2 = 0.41), but no main effect of feature size or an interaction of feature size with time interval (for both effects F (1, 20) < 1). *Corrugator supercilii* activity decreased as a function of time interval.

To directly contrast the *zygomaticus major* activation differences between the babyfaced and the original car fronts against the differences between the two feature-size conditions found for faces, we added object category as a between-participants factor and conducted a 2 (feature size: original versus babyfaced) × 2 (object category: car fronts versus faces) ANOVA, averaged over the five seconds of stimulus presentation (T1 only). The analysis did not show a main effect of object category (F (1, 47) = 1.58, p > .2, η_p^2 = 0.03), or an interaction effect of object category with feature size (F (1, 47) < 1). Hence, *zygomaticus major* activity did not differ in direction and intensity between cars and faces. The main effect of feature size was significant (F (1, 47) = 13.54, p = .001, η_p^2 = 0.22). We do not report the corresponding analysis for *corrugator supercilii* activation differences, since the separate ANOVAs reported above revealed that there was no effect of our variable of interest (i.e., degree of babyfaceness) on *corrugator supercilii* activation, for both cars and faces.

Habituation Effects in Facial EMG Responses (H2)

Regarding our habituation hypothesis, we predicted that responses to the original and the babyfaced cars (faces) were different over the two repeated exposures within the cuteness block. Thus, we analyzed whether the facial EMG responses to the babyfaced stimuli did not habituate (decline) due to repeated exposure, whereas responses to the original stimuli might change. We conducted four 2 (feature size: original versus babyfaced) × 2 (repeated exposure: T1 versus T2) repeated measurement ANOVAs, separately for both muscle sites and the two object categories. As we found no main effect of our feature-size manipulation on *corrugator supercilii* activity when considering responses at T1 (see above), we tested the habituation hypothesis only for *zygomaticus major*. For both T1 and T2, activity was averaged over the five seconds of stimulus presentation because we found no effect of time interval on *zygomaticus major* activation during T1 (see above). Facial EMG data for car fronts and faces are plotted as a function of repeated exposure in Figure 4.

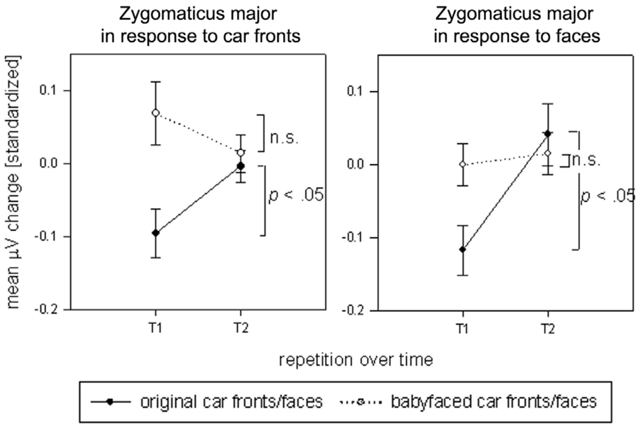

Figure 4. Changes in activation of *zygomaticus major* in response to cars and faces over two stimulus exposures. (Note: T1 = first exposure, T2 = second exposure; n.s. = non-significant, p > .1; values represent mean responses to 16 stimuli averaged over 5 s presentation time)

Car Fronts

The ANOVA on the activity of the *zygomaticus major* revealed a significant two-way interaction of feature size with repeated exposure (F (1, 27) = 4.74, p = .038, η_p^2 = 0.15), a main effect of feature size (F (1, 27) = 7.73, p = .01, η_p^2 = 0.22), but no main effect of repeated exposure (F (1, 27) < 1). To interpret the interaction, we compared the facial EMG responses between T1 and T2, separately for the original and the babyfaced cars. In accordance with the second hypothesis, *zygomaticus major* responses to babyfaced car fronts did not change significantly due to repeated exposure (M_{T1} = 0.07, SD_{T1} = 0.23 versus M_{T2} = 0.01, SD_{T2} = 0.14; F (27) < 1; η_p^2 = 0.03), whereas the *zygomaticus major* responses to the original car fronts significantly increased with repeated exposure (M_{T1} = -0.1, SD_{T1} = 0.18 versus M_{T2} = 0, SD_{T2} = 0.11; F (1, 27) = 4.36, p = .05, η_p^2 = 0.14) and accounted for a slight leveling of the activation difference between babyfaced and original car designs at T2 (see Figure 4). Thus, the simple effect of feature size was significant at the first (see H1) but not at the second exposure (F (1, 27) < 1).

Faces

The ANOVA on the activity of the *zygomaticus major* resulted in a significant two-way interaction of feature size with repeated exposure (F (1, 20) = 4.73, p = .042, η_p^2 = 0.19), no main effect of feature size (F (1, 20) = 2.74, p > .1, η_p^2 = 0.12), and a significant main effect of repeated exposure (F (1, 20) = 5.17, p = .034, η_p^2 =

0.21). A comparison of the facial EMG responses between T1 and T2, separately for the two feature size conditions, revealed that, in accordance with the second hypothesis, *zygomaticus major* responses to babyfaced faces did not change significantly due to repeated exposure ($M_{T1} = 0$, $SD_{T1} = 0.13$ versus $M_{T2} = 0.02$, $SD_{T2} = 0.13$; F (1, 20) < 1; $\eta_p^2 = 0.007$), whereas the *zygomaticus major* responses to the original faces increased with repeated exposure ($M_{T1} = -0.12$, $SD_{T1} = 0.16$ versus $M_{T2} = 0.04$, $SD_{T2} = 0.19$; F (1, 20) = 7.95, $p = .01$, $\eta_p^2 = 0.28$) and even overran the activity triggered by babyfaced faces at T2 (see Figure 4, right panel). Again, the simple effect of feature size was significant at the first (see H1) but not at the second exposure (F (1, 20) < 1).

To directly contrast the effects found for car fronts against the effects found for faces, we again conducted an analysis in which we added object category as a between-participants factor to the ANOVA. The analysis revealed no main effect of object category (F (1, 47) < 1), nor any two-way interaction of object category with the other factors (object category × feature size, F (1, 47) = 1.08, $p > .3$, $\eta_p^2 = 0.02$; object category × repeated exposure, F (1, 47) = 1.43, $p > .23$, $\eta_p^2 = 0.03$), nor a three-way interaction (object category × feature size × repeated exposure, F (1, 47) < 1). Therefore, the habituation effect was not different for cars and faces.

Validity Check: Affective Responses during Attractiveness Evaluation

To control how specific the facial EMG responses to features of a baby schema were assessed during the cuteness evaluation block, we compared these responses with the facial EMG responses from the attractiveness block. We explored this issue not in terms of an additional research question but more as a validity check. Compared to the cuteness block data, four additional participants had to be excluded due to the quantity of EMG artifacts (n = 24; $M_{age} = 22$ yrs, $SD_{age} = 2$ yrs; 67% females). In the face group, data of two participants were excluded for the same reason (n = 23; $M_{age} = 21$ yrs; $SD_{age} = 2$ yrs, 65% females).

Manipulation Check Based on Self-Reported Attractiveness Ratings

Before analyzing the facial EMG responses for the attractiveness block, we checked the impact of our manipulation on perceived attractiveness. We found that the feature-size manipulation did not have a significant effect on the perceived attractiveness of either the cars (averaged over T1 and T2: $M_{babyfaced} = 3.61$, $SD_{babyfaced} = 0.49$ versus $M_{original} = 3.66$, $SD_{original} = 0.46$; $t(23) = 1$, $p = .33$, Cohen's $d = 0.09$), or of the faces ($M_{babyfaced} = 3.63$, $SD_{babyfaced} = 0.73$ versus $M_{original} = 3.59$, $SD_{original} = 0.57$; $t(22) = 0.53$, $p = .60$, Cohen's $d = 0.06$).

Facial EMG Responses to Car Fronts and Faces

To explore the effect of the feature-size manipulation on affective responses, we ran again several 2 (feature size: original versus babyfaced) × 2 (time interval: seconds 1 to 5 after stimulus onset) repeated measurement ANOVAs, separately for the activation of the two muscles sites and the two object categories. For reasons of parsimony, main and interaction effects found in the ANOVAs are summarized in Table 1, separately for T1 and T2. Regarding our main variable of interest, the degree of babyfaceness, we found neither significant main effects of our feature-size manipulation, nor an interaction with time interval on muscle activation, for both cars and faces.

Debriefing Results

As facial EMG is an implicit measure because it infers affective changes from changes in facial muscle activation, it was important to check the participants' awareness of this relationship. Hence, following our main analyses, participants whose debriefing

Table 1. Main and interaction effects of factors Feature Size and Time Interval on muscle activations during attractiveness evaluation. (Note: T1 = first exposure, T2 = second exposure)

			Zygomaticus Major		***Corrugator Supercilii***	
		Factors	***F* value**	***p* value**	***F* value**	***p* value**
Car Fronts	T1	Feature Size	< 1	.67	2.13	.16
		Time Interval	< 1	.64	1.72	.19
		Feature Size × Time Interval	1.18	.32	1.61	.18
	T2	Feature Size	< 1	.75	2.81	.11
		Time Interval	1.71	.19	4.77	.008
		Feature Size × Time Interval	< 1	.56	< 1	.60
Faces	T1	Feature Size	< 1	.61	2.53	.13
		Time Interval	7.14	.003	6.92	.003
		Feature Size × Time Interval	< 1	.44	2.1	.09
	T2	Feature Size	< 1	.36	< 1	.47
		Time Interval	3.48	.05	3.77	.03
		Feature Size × Time Interval	1.18	.32	1.7	.16

statements indicated that they might have had a vague idea of the purpose of the study were eliminated, and all analyses were rerun. According to this strict criterion, seven participants in the car group and four additional participants in the face group were excluded. For the two hypotheses, we found the same patterns of effects as in the original analyses, although some results failed to reach statistic significance at a 5% level due to the reduced power of this test.

General Discussion of the Results

As the human mind has evolved over millions of years to enable adaptive responses to complex environments, modern consumers’ responses to products and their physical appearance still might be shaped by deeply embedded psychological mechanisms. In the present paper, we studied the effects of evolutionarily significant design features on affective consumer responses and manipulated car fronts and faces in accordance with features of the baby schema. Assessing behavioral cuteness ratings and facial EMG responses to these babyfaced stimuli compared to original stimuli, for both car fronts and faces we found effects of our manipulation on positive affect. Babyfaced car fronts and faces were perceived as cuter than the original stimuli when rated explicitly and, in line with the behavioral data, babyfaced car fronts and faces elicited larger activations of the smiling muscle, the *zygomaticus major*, than the original stimuli. Interestingly, most of our participants did not show any overt facial expressions during the experimental session, therefore, the implicit affective responses elicited by our stimuli were subtle, but nevertheless measurable by facial EMG. In line with the evolutionary framework, our assumption that affective responses to baby-schema cues occur very quickly (and presumably automatically) was supported: differences in activation between babyfaced and original stimuli occurred within the first second after stimulus onset for cars and within the first two seconds for faces. No difference in *corrugator supercilii* activity to babyfaced cars (faces) and the original stimuli was observed. On the one hand, the results suggest that positive affect toward product designs is increased due to features of the baby schema, but that negative affect is not decreased; this is in line with a two-dimensional affect model rather than a bipolar valence continuum (see Cacioppo & Berntson, 1994). On the other hand, we cannot rule out that the missing difference in *corrugator supercilii* activity was an effect of our stimulus manipulation procedure. We compared existing car designs and faces against babyfaced versions of the stimuli. If we chose a stronger manipulation, for example by comparing babyfaced against maturefaced stimuli (e.g., Keating et al., 2008; Zebrowitz et al., 2009), we might have found the expected effect on negative affect.

We further studied the habituation of positive affective responses to babyfaced car designs (faces). We did not find changes in facial EMG responses to babyfaced stimuli over two exposures, which supports our prediction that affective responses to designs which mimic features of the baby schema are not susceptible to repetition and habituation. However, even though affective responses to the babyfaced stimuli were stable, affective responses to the original stimuli increased with repeated exposure, which was congruent with repetition effects demonstrated by other authors (e.g., Cox & Cox, 2002). This increase of activation triggered by the original stimuli accounted for a slight leveling of the affective responses to babyfaced and original stimuli at the second exposure, suggesting that the baby-face “advantage” is only present when consumers see a design for the first time. However, as we examined habituation effects by presenting a stimulus only twice within a block, our result is an interesting but tentative starting point. In particular concerning the practical relevance, future studies should consider more than two repetitions to study the time course of affective responses to evolutionarily significant shapes such as the baby schema in product designs more specifically (as in Tinio & Leder, 2009). It might be interesting to test whether designs mimicking evolutionarily significant features surpass neutral designs (i.e., designs without such features) in the long run, since affective responses to, for example, babyfaced designs should remain stable over many exposures, whereas responses to neutral designs might eventually result in boredom.

In addition to cuteness, we assessed attractiveness evaluations and found no effects of our baby-face manipulation on explicit judgments and muscle activations when participants rated the car designs (faces) for attractiveness. This might be surprising because babyfaceness could enhance attractiveness (e.g., Zebrowitz, 1997, p. 127). However, the relationship between babyfaceness and attractiveness is complex and far from clear, and whether there is a positive relationship depends on several context factors (e.g., Keating, 1985). Further, this null result is in line with other authors’ results who found that differences in affective responses to babyfaced and maturefaced persons cannot be accounted for by variations in attractiveness (e.g., Zebrowitz et al., 2007, p. 6). As a consequence of stimulus generalization, affective responses to the baby schema in car designs and adult faces should be smaller than the affective responses naturally elicited by real babies, so that they might be easy to overwrite in situations where the detection of the baby schema is less relevant. We assume that other evaluative dimensions for which the detection is relevant and which are related more directly to babyfaceness than global attractiveness evaluations are (e.g., perceptions of weakness, warmth, and honesty; Berry & Zebrowitz, 1985), would have also produced an increased positive affect.

In our research, we focused on rapid and presumably automatic affective consumer reactions to the baby schema. We are aware that the automaticity of the affective responses in our study is speculative. Although the responses occurred immediately after stimulus onset, as a consequence of our study design (the cuteness concept was “pre-activated” in the participants’ mind by asking for cuteness ratings), we do not know how facial EMG responses would have looked if the participants had only gazed at the pictures without simultaneously completing a rating task (e.g., Hoefel & Jacobsen, 2007; Lange et al., 2003). Thus, more research is needed to gain deeper insights into the extent of the automatic nature of affective responses to babyfaced designs.

To summarize, our results not only confirmed other studies' evidence that consumers detect evolutionarily significant shapes (e.g., faces) in artifacts (Windhager et al., 2010; Windhager et al., 2008), but also, more importantly, that consumers show rapid affective responses to cute product designs, which might represent presumably innate affective responses and which were stable over repeated exposure. To collect further supportive evidence for the universal power of an evolutionary framework, further research is needed to test whether the effects examined in our study can be also found for other evolutionary relevant shapes such as erotic or scary.

Implications for Product Design and Marketing

Our results support the idea that consumers are sensitive to evolutionarily significant shapes in product designs. Based on our findings, designers can increase the affective value of products by creating cute designs which can benefit from the human predisposition to feel attracted by baby-schema cues (e.g., by emphasizing or exaggerating the features of visual key stimuli in product designs, such as very large headlights). In our study, we applied features of a baby schema solely to car fronts, building our research on existing evidence about face-like product designs. However, since we consider the baby-schema response to be universal, the design concept of "visual cuteness" might be applicable to other feature dimensions than headlights, air-intake, and grille (e.g., proportions of windshield/forehead), and to other product categories than cars (e.g., cell phones). We found affective responses to babyfaced product designs only when cuteness ratings were required, but not when a design's general attractiveness was evaluated. This suggests that to activate positive effects of baby-schema features, marketers have to create a consumption context where the cuteness response is relevant (e.g., presenting a product as needing care), so that consumers become more sensitive to babyfaced design features. Further, for application in the realm of product design it is important to understand how and when such fast and subtle affective responses as examined in our study influence explicit behavioral responses such as purchase. Concerning the relationship between affect and behavior, product-, consumer-, and situation-related boundary conditions might be taken into account. For example, certain product types (e.g., muscle cars, trucks) should not benefit from visual cuteness, as such products are rather associated with traits contrary to cuteness (e.g., strong, mature). Further, we assume that evolutionarily triggered affect is especially effective under low-involvement conditions when consumers base their choices more on "gut feelings" than on conscious thought.

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References

1. Aggarwal, P., & McGill, A. L. (2007). Is that car smiling at me? Schema congruity as a basis for evaluating anthropomorphized products. *Journal of Consumer Research, 34*(4), 468-479.
2. Bar, M., & Neta, M. (2006). Humans prefer curved visual objects. *Psychological Science, 17*(8), 645-648.
3. Berlyne, D. E. (1970). Novelty, complexity, and hedonic value. *Perception and Psychophysics, 8*(5), 279-286.
4. Berry, D. S. (1991). Attractive faces are not all created equal: Joint effects of facial babyishness and attractiveness on social perception. *Personality and Social Psychology Bulletin, 17*(5), 523-531.
5. Berry, D. S., & Zebrowitz, L. (1985). Some components and consequences of a babyface. *Journal of Personality and Social Psychology, 48*(2), 312-323.
6. Blijlevens, J., Creusen, M. E. H., & Schoormans, J. P. L. (2009). How consumers perceive product appearance: The identification of three product appearance attributes. *International Journal of Design*, *3*(3), 27-35.
7. Bornstein, R. F. (1989). Exposure and affect: Overview and meta-analysis of research, 1968-1987. *Psychological Bulletin*, *106*(2), 265-289.
8. Brosch, T., Sander, D., & Scherer, K. R. (2007). That baby caught my eye…Attention capture by infant faces. *Emotion, 7*(3), 685-689.
9. Buss, D. (1994). *The evolution of desire: Strategies of human mating*. New York: Basic Books.
10. Cacioppo, J. T., & Berntson, G. G. (1994). Relationship between attitudes and evaluative space: A critical review, with emphasis on the separability of positive and negative substrates. *Psychological Bulletin, 115*(3), 401-423.
11. Cacioppo, J. T., Petty, R. E., Losch, M. E., & Kim, H. S. (1986). Electromyographic activity over facial muscle regions can differentiate the valence and intensity of affective reactions. *Journal of Personality and Social Psychology, 50*(2), 260-268.
12. Chandler, J., & Schwarz, N. (2010). Use does not wear ragged the fabric of friendship: Thinking of objects as alive makes people less willing to replace them. *Journal of Consumer Psychology, 20*(2), 138-145.
13. Chang, W. C., & Wu, T. Y. (2007). Exploring types and characteristics of product forms. *International Journal of Design, 1*(1), 3-14.
14. Chitturi, R. (2009). Emotions by design: A consumer perspective. *International Journal of Design, 3*(2), 7-17.
15. Colarelli, S. M., & Dettman, J. R. (2003). Intuitive evolutionary perspectives in marketing practices. *Psychology & Marketing, 20*(9), 837-865.
16. Coss, R. G. (2003). The role of evolved perceptual biases in art and design. In E. Voland & K. Grammer (Eds.), *Evolutionary aesthetics* (pp. 69-130). Berlin, Heidelberg: Springer.

17. Cox, D. S., & Cox, A. D. (1988). What does familiarity breed? Complexity as a moderator of repetition effects in advertisement evaluation. *Journal of Consumer Research, 15*(1), 111-116.
18. Cox, D. S., & Cox, A. D. (2002). Beyond first impressions: The effects of repeated exposure on consumer liking of visually complex and simple product designs. *Journal of the Academy of Marketing Science, 30*(2), 119-130.
19. Delorme, A., & Makeig, S. (2004). EEGLAB: An open source toolbox for analysis of single-trial EEG dynamics. *Journal of Neuroscience Methods, 134*(1), 9-21.
20. Desmet, P. (2003). A multilayered model of product emotions. *The Design Journal*, *6*(2), 4-13.
21. Desmet, P., Hekkert, P., & Jacobs, J. J. (2000). When a car makes you smile: Development and application of an instrument to measure product emotions. *Advances in Consumer Research, 27*(1), 111-117.
22. Desmet, P., Overbeeke, K., & Tax, S. (2001). Designing products with added emotional value: Development and application of an approach for research through design. *The Design Journal, 4*(1), 32-47.
23. Dimberg, U. (1990). Facial electromyography and emotional reactions. *Psychophysiology, 27*(5), 481-494.
24. Dimberg, U., & Thunberg, M. (1998). Rapid facial reactions to emotional facial expressions. *Scandinavian Journal of Psychology, 39*(1), 39-45.
25. Dimberg, U., Thunberg, M., & Elmehed, K. (2000). Unconscious facial reactions to emotional facial expressions. *Psychological Science, 11*(1), 86-89.
26. DiSalvo, C., & Gemperle, F. (2003). From seduction to fulfillment: The use of anthropomorphic form in design. In *Proceedings of the 1st International Conference on Designing Pleasurable Products and Interfaces* (pp. 67-72). New York: ACM.
27. Durante, K. M., Griskevicius, V., Hill, S. E., Perilloux, C., & Li, N. P. (2010). Ovulation, female competition, and product choice: Hormonal influences on consumer behavior. *Journal of Consumer Research, 37*(6), 921-934.
28. Eisenstein, E. M., Eisenstein, D., & Smith, J. C. (2001). The evolutionary significance of habituation and sensitization across phylogeny: A behavioral homeostasis model. *Integrative Physiological and Behavioral Science, 36*(4), 251-265.
29. Ekman, P. (1982). *Emotion in the human face*. New York: Cambridge University Press.
30. Ekman, P., & Friesen, W. V. (1975). *Unmasking the face: A guide to recognizing emotions from facial clues*. Englewood Cliffs, NJ: Prentice Hall.
31. Ekman, P., Friesen, W. V., & Ancoli, S. (1980). Facial signs of emotional experience. *Journal of Personality & Social Psychology, 39*(6), 1125-1134.
32. Ellis, H. D., & Young, A. W. (1998). Faces in their social and biological context. In A. W. Young (Ed.), *Face and mind* (pp. 67-96). Oxford: Oxford University Press.
33. Epley, N., Waytz, A., & Cacioppo, J. T. (2007). On seeing human: A three-factor theory of anthropomorphism. *Psychological Review, 114*(4), 864-886.
34. Fridlund, A. J., & Cacioppo, J. T. (1986). Guidelines for human electromyographic research. *Psychophysiology, 23*(5), 567-589.
35. Gerger, G., Leder, H., Tinio, P. P. L., & Schacht, A. (2011). Faces versus patterns: Exploring aesthetic reactions using facial EMG. *Psychology of Aesthetics, Creativity, and the Arts, 5*(3), 241-250.
36. Glocker, M. L., Langleben, D. D., Ruparel, K., Loughead, J. W., Gur, R. C., & Sachser, N. (2009). Baby schema in infant faces induces cuteness perception and motivation for caretaking in adults. *Ethology*, *115*(3), 257-263.
37. Glocker, M. L., Langleben, D. D., Ruparel, K., Loughead, J. W., Valdez, J. N., Griffin, M. D., … Gur, R. C. (2009). Baby schema modulates the brain reward system in nulliparous women. *Proceedings of the National Academy of Science, 106*(22), 9115-9119.
38. Gorn, G. J., Jiang, Y., & Johar, G. V. (2008). Babyfaces, trait inferences, and company evaluations in a public relations crisis. *Journal of Consumer Research, 35*(1), 36-49.
39. Griskevicius, V., Shiota, M. N., & Nowlis, S. M. (2010). The many shades of rose-colored glasses: An evolutionary approach to the influence of different positive emotions. *Journal of Consumer Research, 37*(2), 238-250.
40. Guthrie, S. E. (1993). *Faces in the clouds: A new theory of religion*. New York: Oxford.
41. Hildebrandt, K. A., & Fitzgerald, H. E. (1978). Facial feature determinants of perceived infant attractiveness. *Infant Behavior and Development, 2*(1), 329-339.
42. Hoefel, L., & Jacobsen, T. (2007). Electrophysiological indices of processing aesthetics: Spontaneous or intentional processes? *International Journal of Psychophysiology, 65*(1), 20-31.
43. Jacob, J. E., Rodenhauser, P., & Markert, R. J. (1987). The benign exploitation of human emotions: Adult women and the marketing of cabbage patch kids. *Journal of American Culture, 10*(3), 61-71.
44. Jenkins, S. D., Brown, R. D. H., & Rutterford, N. (2009). Comparing thermographic, EEG, and subjective measures of affective experience during simulated product interactions. *International Journal of Design, 3*(2), 53-65.
45. Keating, C. F. (1985). Gender and the physiognomy of dominance and attractiveness. *Social Psychology Quarterly, 48*(1), 61-70.
46. Keating, C. F., Randall, D. W., Kendrick, T., & Gutshall, K. A. (2003). Do babyfaced adults receive more help? The (cross-cultural) case of the lost resume. *Journal of Nonverbal Behavior, 27*(2), 89-108.
47. Landwehr, J. R., McGill, A. L., & Herrmann, A. (2011). It's got the look: The effect of friendly and aggressive

"facial" expressions on product liking and sales. *Journal of Marketing, 75*(3), 132-146.

48. Lang, P. J. (1985). *The cognitive psychophysiology of emotion: Anxiety and the anxiety disorders*. Hillsdale, HJ: Lawrence Erlbaum.
49. Lang, P. J., Greenwald, M. K., Bradley, M. M., & Hamm, A. O. (1993). Looking at pictures: Affective, facial, visceral, and behavioral reactions. *Psychophysiology, 30*(3), 261-273.
50. Lange, K., Williams, L. M., Young, A. W., Bullmore, E. T., Brammer, M. J., Williams, S. C. R., … Phillips, M. L. (2003). Task instructions modulate neural responses to fearful facial expressions. *Biological Psychiatry, 53*(3), 226-232.
51. Livingston, R. W., & Pearce, N. A. (2009). The teddy-bear effect: Does having a baby face benefit black chief executive officers? *Psychological Science, 20*(10), 1229-1236.
52. Lobmaier, J. S., Sprengelmeyer, R., Wiffen, B., & Perrett, D. I. (2010). Female and male responses to cuteness, age and emotion in infant faces. *Evolution and Human Behavior, 31*(1), 16-21.
53. Lorenz, K. (1943). Die angeborenen Formen möglicher Erfahrung [Innate forms of potential experience]. *Zeitschrift für Tierpsychologie, 5*(2), 235-409.
54. Marcus, A. (2002). The cult of cute – The challenge of user experience design. *Interactions*, *9*(6), 29-34.
55. Miesler, L., Landwehr, J. R., Herrmann, A., & McGill, A. L. (2010). Consumer and product face-to-face: Antecedents and consequences of spontaneous face-schema activation. *Advances in Consumer Research, 37*, 536-537.
56. Nitschke, J. B., Nelson, E. E., Rusch, B. D., Fox, A. S., Oakes, T. R., & Davidson, R. J. (2004). Orbitofrontal cortex tracks positive mood in mothers viewing pictures of their newborn infants. *NeuroImage, 21*(2), 583-592.
57. Olsen, I. R., & Marshuetz, C. M. (2005). Facial attractiveness is appraised in a glance. *Emotion, 5*(4), 498-502.
58. Patton, P. (1998, October 29). Utensils get cute. *The New York Times*. Retrieved September 17, 2008, from http://www.nytimes.com
59. Pham, M. T. (1998). Representativeness, relevance, and the use of feelings in decision making. *Journal of Consumer Research*, *25*(2), 144-160.
60. Pittenger, J. B., & Shaw, R. E. (1975). Aging faces as viscal-elastic events: Implications for a theory of nonrigid shape perception. *Journal of Experimental Psychology: Human Perception and Performance, 1*(4), 374-382.
61. Poels, K., & DeWitte, S. (2006). *How to capture the heart? Reviewing 20 years of emotion measurement in advertising* (Working paper). KU Leuven: Department of Marketing and Organisation Studies. Retrieved June 6, 2011, from https://lirias.kuleuven.be/bitstream/123456789/228488/1/MO_0605.pdf
62. Rozin, P. (1976). Psychological and cultural determinants of food choice. In T. Silverstone (Ed.), *Appetite and food intake* (pp. 286-312). Berlin: Dahlem Konferenzen.
63. Saad, G. (2008). The collective amnesia of marketing scholars regarding consumers' biological and evolutionary roots. *Marketing Theory, 8*(4), 425-448.
64. Saad, G., & Gill, T. (2000). Applications of evolutionary psychology in marketing. *Psychology & Marketing, 17*(12), 1005-1034.
65. Sander, D., Grandjean, D., & Scherer, K. R. (2005). A systems approach to appraisal mechanisms in emotion. *Neural Networks*, *18*(4), 317-352.
66. Sanefuji, W., Ohgami, H., & Hashiya, K. (2007). Development of preference for baby faces across species in humans (homo sapiens). *Journal of Ethology, 25*(3), 249-254.
67. Schwarz, N., & Clore, G. L. (1988). How do I feel about it? Informative functions of affective states. In K. Fiedler & J. Forgas (Eds.), *Affect, cognition, and social behaviour* (pp. 44-62). Toronto: Hofgrefe International.
68. Sherman, G. D., Haidt, J., & Coan, J. A. (2009). Viewing cute images increases behavioral carefulness. *Emotion, 9*(2), 282-286.
69. Sprengelmeyer, R., Perrett, D. I., Fagan, E. C., Cornwell, R. E., Lobmaier, J. S., Sprengelmayer, R., … Young, A. W. (2009). The cutest little baby face: A hormonal link to sensitivity to cuteness in infant faces. *Psychological Science, 20*(2), 149-154.
70. Tinio, P. P. L., & Leder, H. (2009). Just how stale are aesthetic features? Symmetry, complexity and the jaws of massive familiarization. *Acta Psychologica, 130*(3), 241-250.
71. Topolinski, S., Likowski, K. U., Weyers, P., & Strack, F. (2009). The face of fluency: Semantic coherence automatically elicits a specific pattern of facial muscle reactions. *Cognition & Emotion, 23*(2), 260-271.
72. Voland, E., & Grammer, K. (2003). *Evolutionary aesthetics*. Berlin, Heidelberg: Springer.
73. Wang, Y. J., & Minor, M. S. (2008). Validity, reliability, and applicability of psychophysiological techniques in marketing research. *Psychology & Marketing, 25*(2), 197-232.
74. Welsh, J. (2006, March 10). Why cars got angry. *Wall Street Journal*, p. W1.
75. Weyers, P., Mühlberger, A., Hefele, C., & Pauli, P. (2006). Electromyographic responses to static and dynamic avatar emotional facial expressions. *Psychophysiology, 43*(5), 450-453.
76. Willis, J., & Todorov, A. (2006). First impressions: Making up your mind after a 100-ms exposure to a face. *Psychological Science*, *17*(7), 592-598.
77. Windhager, S., Hutzler, F., Carbon, C.-C., Oberzaucher, E., Schaefer, K., Thorstensen, T., … Grammer, K. (2010). Laying eyes on headlights: Eye movements suggest facial features in cars. *Collegium Antropologicum, 43*(3), 1075-1080.
78. Windhager, S., Slice, D. E., Schaefer, K., Oberzaucher, E., Thorstensen, T., & Grammer, K. (2008). Face to face: The perception of automotive designs. *Human Nature*, *19*(4), 331-346.

79. Winkielman, P., & Cacioppo, J. T. (2001). Mind at ease puts a smile on the face: Psychophysiological evidence that processing facilitation elicits positive affect. *Journal of Personality and Social Psychology, 81*(6), 989-1000.
80. Winkielman, P., Berridge, K.C., & Wilbarger, J.L. (2005). Unconscious affective reactions to masked happy versus angry faces influence consumption behavior and judgments of value. *Personality and Social Psychology Bulletin, 31*(1), 121-135.
81. Zajonc, R. B. (1980). Feeling and thinking. Preferences need no inferences. *American Psychologist, 35*(2), 151-175.
82. Zebrowitz, L. A. (1997). *Reading faces: Window to the soul?* Boulder, CO: Westview Press.
83. Zebrowitz, L. A., Fellous, J.-M., Mignault, A., & Andreolletti, C. (2003). Trait impressions as overgeneralized responses to adaptively significant facial qualities: Evidence from connectionist modeling. *Personality and Social Psychology Review, 7*(3), 194-215.
84. Zebrowitz, L. A., Luevano, V. X., Bronstad, P. M., & Aharon, I. (2007). Neural activation to babyfaced men matches activation to babies. *Social Neuroscience, 4*(1), 1-10.
85. Zebrowitz, L. A., & Montepare, J. M. (1992). Impressions of babyfaced individuals across the life span. *Developmental Psychology, 28*(6), 1143-1152.