Abstract Over evolutionary time, humans have developed a selective sensitivity to features in the human face that convey information on sex, age, emotions, and intentions. This ability might not only be applied to our conspecifics nowadays, but also to other living objects (i.e., animals) and even to artificial structures, such as cars. To investigate this possibility, we asked people to report the characteristics, emotions, personality traits, and attitudes they attribute to car fronts, and we used geometric morphometrics (GM) and multivariate statistical methods to determine and visualize the corresponding shape information. Automotive features and proportions are found to covary with trait perception in a manner similar to that found with human faces. Emerging analogies are discussed. This study should have implications for both our understanding of our prehistoric psyche and its interrelation with the modern world.

Keywords Automobiles · Faces · Geometric morphometrics · Human perception · Maturity · Trait allocation
The patterns of culture that we create and consume, although not adaptations in themselves, might reveal about human evolutionary psychology as much as or more than the most carefully planned psychological experiments (Buss 2004:410).

Humans seem to have a general perceptual strategy that leads to the phenomena of animism and anthropomorphism. Animism is the attribution of life to the non-living, whereas anthropomorphism is the interpretation of non-human beings and things in human terms (Guthrie 1993). This hyperactive agent-detection device has evolved because the adaptive advantage of detecting every agent is much higher than the costs of being mistaken (Bulbulia 2004). In this way, our brain will try to interpret even its non-social environment as primarily social—because of the adaptive advantage to find and gather information from faces, which is necessary to detect personal identity, possible kin relationships, personality and facial expressions, and action tendencies (Cosmides and Tooby 1992). As a result, we are tempted to see faces everywhere, even in clouds, stones, and cars (Guthrie 1993).

The human face is a complex multi-signal system from which we can infer a great deal of information at no more than a glance—in other words, after only 100 ms of exposure (Willis and Todorov 2006). Such information refers to age, sex, attitudes, personality traits, and emotions.

Body proportions play an important role. Since structures grow proportionally more and for a longer period of time the further they are from the neurocranium (Enlow and Hans 1996), babies and young children have relatively large eyes and large, protruding foreheads as compared with adults, constituting the so-called Kindchenschema (Lorenz 1943). Furthermore, babyish characteristics in adult faces influence perception of personal traits (Keating et al. 2003). Facial shape also differs between the sexes, with males having the more pronounced lower faces owing to extended growth (Fink et al. 2005; Ursi et al. 1993). Humans attribute dominance to faces characterized by a prominent chin, heavy brow ridges, and a muscular face (see Buss 2004 for a review; Grammer and Thornhill 1994).

Indeed, facial features, including structural elements as well as static facial expressions, may influence one’s perception of another person’s personality (see Argyle 2002 for a review). For the personality, five cross-culturally valid factors (agreeableness, conscientiousness, extroversion, neuroticism, and openness/culture) are often applied (McCrae and Costa 1997). Personality and facial expressions are found to interrelate in that extroversion, agreeableness, and culture significantly correlate with smiling (Kenny et al. 1992). Important components in facial expressions of emotions include the eyebrows, eyelids, and mouth. Their movements form the global pattern of such widely recognized expressions as happiness, sadness, surprise, disgust, anger, and fear (Ekman 1999).

In summary, people draw many inferences from a stranger’s face. Owing to the evolutionary significance of decoding facial signals, humans seem to have developed a selective sensitivity to the relevant features and configurations, even if presented in rather abstract ways (Thayer and Schiff 1969, as cited in Argyle 2002). We predict that such information is also encoded and perceived in car fronts, which is supported by Desmet et al. (2000). The idea that cars have faces has been proposed by both researchers (e.g., Coss 2003; Erk et al. 2002) and product designers (Kerssenbrock...
The tendency to interpret car fronts as faces could be the result of an error management strategy—which has evolved in order not to miss any information about faces, as outlined above. Such a tendency, if it exists, can be independent of the way the processing itself is done because the result is independent of the way it is reached. With evidence that such interpretation or direct processing occurs, the approach can be extended to the interpretation of car fronts as facelike, and then the same information could be extracted as it would be from faces themselves. This would be an indirect proof of the hypothesis.

We therefore expect ratings of car fronts to vary with aspects of their geometry in a manner consistent with that in faces.

We will quantify and visualize the link between perception and the geometry of a car front and its constituent parts. For this purpose, we emphasize geometric morphometric (GM) methods. In contrast to classic morphometric approaches, GM is not based on distances, angles, or ratios, but on the 2- or 3D coordinates of “landmarks” (see Bookstein 1991). A standardization process, the generalized Procrustes analysis (GPA), allows the investigation of shape independent of differences in the scale, orientation, and location of the specimens (Rohlf and Slice 1990). The resulting shape coordinates can then be used for further analyses, such as multivariate regression or partial least squares (PLS) analysis. Results of such analyses are again landmark coordinates and/or their linear combinations. The technique of thin-plate splines, as introduced in the context of GM by Bookstein (1991), provides the interpolation of differences at landmarks. The resulting deformation grids enable us to assess intuitively what might otherwise be disguised in large tables of numbers. Besides the possibility of visualizing the results, the ability to show a significant regression model of trait perception on car form comparable to that found on human facial shape would be strong support for the hypothesis.

If people indeed interpret the object world socially as a by-product of an evolutionary adaptation, we expect to be able to reconstruct changes in the proportions and morphology of car fronts that covary with the perception of traits analogous to those of human faces. Furthermore, we explore which shapes of car fronts people like.

In summary, our hypotheses are: First, car fronts possess cues from which we infer such characteristics as maturity, gender, attitudes, emotions, and personality. If this is the case, people will show high interrater agreement. Second, shape contributes to the variation of attributions among cars.

**Material and Methods**

**Participants**

Twenty males and 20 females between 19 and 33 years of age (mean=24.53, SD=3.013) participated in the experiment, and each received 10 euro compensation. All were respondents to a university advertisement and were of Central European descent.
Stimuli

We used high-resolution 3D computer models (digital mockups) of 38 cars, representing 26 manufacturers (brands). They were accurate reconstructions of actual car models from 2004 to 2006 edited via 3ds Max® (Autodesk 2006). We scaled the cars to their original size and positioned a virtual camera with a 200 mm lens at a point 12 m from and half the height of the respective car. Lighting was standardized using a virtual sun. All cars were colored silver and license plates erased, although brand logos were retained. Finally, we rendered pictures at 640×480 pixels.

Procedure

On a computer monitor, cars were displayed in random order for the raters. Each participant rated each car on 19 traits (see below) using an onscreen slider that produced results from 0 (unipolar: not at all, bipolar: a lot of one extreme) to 100 (unipolar: a lot, bipolar: a lot of the other extreme). Subjects were subsequently shown printed images of all the cars in random order, one at a time, and were asked to mark on a continuous 10 cm line the extent to which they perceived this car to have a face and whether they associate the car front with a human face, an animal face, or no face at all. Finally, they were asked to mark facial features (eyes, nose, mouth, ears) on the picture when and where they perceived them.

Statistical Analyses and Geometric Morphometrics

Individual traits were assessed for consistency using Cronbach’s alpha. Traits scoring ≥0.75 were retained. Average values for each trait per car were subjected to a principal components analysis (PCA) based on the covariance matrix. Geometric

<table>
<thead>
<tr>
<th>Landmarks</th>
<th>Definition</th>
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<tbody>
<tr>
<td>1–4</td>
<td>Corners of the windshield</td>
</tr>
<tr>
<td>5–6</td>
<td>Center of the rearview mirrors, left and right</td>
</tr>
<tr>
<td>7, 9</td>
<td>Extremes of the outer/inner edges of the left headlight (from the position of the viewer)</td>
</tr>
<tr>
<td>8, 10</td>
<td>Extremes of the top/lower edges of the left headlight (from the position of the viewer)</td>
</tr>
<tr>
<td>11,13</td>
<td>Extremes of the outer/inner edges of the right headlight (from the position of the viewer)</td>
</tr>
<tr>
<td>12,14</td>
<td>Extremes of the top/lower edges of the right headlight (from the position of the viewer)</td>
</tr>
<tr>
<td>15–16</td>
<td>Broadest part of the grille; i.e., points of greatest lateral extension</td>
</tr>
<tr>
<td>17–18</td>
<td>Highest and lowest point of the grille at the midline (defined by the bilateral symmetry of the car)</td>
</tr>
<tr>
<td>19–20</td>
<td>Broadest part of the additional air intake slots (inner part); i.e., points of greatest lateral extension</td>
</tr>
<tr>
<td>21–22</td>
<td>Highest and lowest point of the additional air intake slots (inner part) on the midline</td>
</tr>
<tr>
<td>23–24</td>
<td>Broadest part of additional lateral structures of additional air-intake slots and/or additional lights</td>
</tr>
<tr>
<td>25–26</td>
<td>Intersection of front tires and car body closest to the midline</td>
</tr>
<tr>
<td>27–28</td>
<td>Outside corner of the tread of the left/right tires</td>
</tr>
<tr>
<td>29–30</td>
<td>Greatest lateral extension of the car</td>
</tr>
<tr>
<td>31–32</td>
<td>Inside corner of the tread of the left/right tires</td>
</tr>
<tr>
<td>33–34</td>
<td>Middle of the top/lower edges of the windshield</td>
</tr>
</tbody>
</table>
morphometrics was used to explore the relationship between car shape and trait scores. For this, we defined 34 landmarks (Table 1, Fig. 1). The bilateral symmetry of the car defined the midline. “Highest” and “lowest” points were determined parallel to this axis, and “greatest lateral extensions” perpendicular to the midline.

The sets of landmarks, digitized in tpsDig (Rohlf 2005a), were superimposed using GPA (Rohlf and Slice 1990). The resulting shape coordinates were then regressed onto car scores on individual PC axes and onto the mean “liking” score. The relationship between shape and perception was further explored using partial least squares (PLS) analysis (Rohlf and Corti 2000; Streissguth et al. 1993). For all such analyses, we used thin-plate splines for the visualization of the results.

Analyses and visualizations were carried out in R (PCA and general statistics), SPSS 12 (Cronbach’s alpha), tpsRegr (Rohlf 2005c), and tpsPLS (Rohlf 2005b).

Results

Interrater Agreement

The Cronbach’s alpha values show high consistency in the ratings (Table 2). Alpha values for five traits fell below the modestly conservative criterion of 0.75. These traits were excluded from further analyses.

Principal Components Analysis (PCA)

A PCA of the average scores per car showed the first principal component (PC) to account for 83% of total variation, the second for nearly 10%, while the others add less than 3% each. This suggests variation in the perception of car characteristics is essentially one- or two-dimensional.

When we take coefficients with absolute values above 0.27 (the constant value of coefficients for an isometric vector in this 13-variable case), positive scores on PC1 indicate cars perceived as adult, dominant, arrogant, angry, masculine, and hostile, with the reverse being true for cars with negative scores (Table 3). We will refer to this axis as “power.” The second PC shows positive coefficients for content (i.e.,
satisfied), happy, open, submissive-dominant, child-adult, and agreeable, and negative coefficients for afraid and angry (Table 3). We call this axis “sociability.” Scores of individual cars are plotted in Fig. 2.

The PCA provides insight into the patterns of covariance of traits across different makes and models of automobiles, but it does not directly address the corresponding shape information. That is the subject of the following analyses.

### Shape Regressions

The multivariate, multiple regression of the GPA shape coordinates onto the first two PCs explained 17% of total shape variation (randomization test: \( P = 0.001 \)). Separate regressions onto PC1 and PC2 explained 13.3% and 3.8%, respectively, with \( P-\)

<table>
<thead>
<tr>
<th>Variable</th>
<th>PC1</th>
<th>PC2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child–Adult</td>
<td>0.48</td>
<td>0.27</td>
</tr>
<tr>
<td>Male–Female</td>
<td>-0.32</td>
<td>-0.18</td>
</tr>
<tr>
<td>Friendly–Hostile</td>
<td>0.32</td>
<td>-0.24</td>
</tr>
<tr>
<td>Submissive–Dominant</td>
<td>0.38</td>
<td>0.29</td>
</tr>
<tr>
<td>Angry</td>
<td>0.32</td>
<td>-0.28</td>
</tr>
<tr>
<td>Afraid</td>
<td>-0.24</td>
<td>-0.29</td>
</tr>
<tr>
<td>Happy</td>
<td>-0.15</td>
<td>0.44</td>
</tr>
<tr>
<td>Surprised</td>
<td>-0.17</td>
<td>0.03</td>
</tr>
<tr>
<td>Open</td>
<td>-0.14</td>
<td>0.35</td>
</tr>
<tr>
<td>Agreeable</td>
<td>-0.18</td>
<td>0.27</td>
</tr>
<tr>
<td>Content</td>
<td>-0.05</td>
<td>0.45</td>
</tr>
<tr>
<td>Arrogant</td>
<td>0.38</td>
<td>-0.02</td>
</tr>
<tr>
<td>Aroused</td>
<td>0.13</td>
<td>-0.02</td>
</tr>
</tbody>
</table>

Values in italics indicate major contributions of this variable to the PC groupings.

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**Table 2** Interrater agreement (variables sorted in descending order of agreement among all 40 subjects)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cronbach’s alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child–Adult</td>
<td>0.97</td>
</tr>
<tr>
<td>Submissive–Dominant</td>
<td>0.96</td>
</tr>
<tr>
<td>Arrogant</td>
<td>0.95</td>
</tr>
<tr>
<td>Friendly–Hostile</td>
<td>0.94</td>
</tr>
<tr>
<td>Angry</td>
<td>0.94</td>
</tr>
<tr>
<td>Male–Female</td>
<td>0.94</td>
</tr>
<tr>
<td>Afraid</td>
<td>0.91</td>
</tr>
<tr>
<td>Happy</td>
<td>0.85</td>
</tr>
<tr>
<td>Surprised</td>
<td>0.84</td>
</tr>
<tr>
<td>Agreeable</td>
<td>0.82</td>
</tr>
<tr>
<td>Open</td>
<td>0.81</td>
</tr>
<tr>
<td>Content</td>
<td>0.76</td>
</tr>
<tr>
<td>Aroused</td>
<td>0.75</td>
</tr>
<tr>
<td>Disgusted</td>
<td>0.68</td>
</tr>
<tr>
<td>Extroverted</td>
<td>0.63</td>
</tr>
<tr>
<td>Sad</td>
<td>0.60</td>
</tr>
<tr>
<td>Neurotic</td>
<td>0.59</td>
</tr>
<tr>
<td>Conscientious</td>
<td>0.43</td>
</tr>
<tr>
<td>I like the car</td>
<td>0.87</td>
</tr>
<tr>
<td>Does this car have a face?(a)</td>
<td>0.81</td>
</tr>
</tbody>
</table>

We found considerable agreement for most of the variables. No car had more than two ratings missing. Five variables with Cronbach’s alpha <0.75 were excluded from further analysis.

\(a\) Based on 15 cars and 39 subjects (one person never answered adequately on paper) because of 27 missing values.
Fig. 2  Position of individual cars on PC1 “power” and PC2 “sociability”. The variation in the perception of car characteristics is essentially one-dimensional.

Fig. 3  Regression of shape onto PC1 “power” (top) and PC2 “sociability” (bottom)—predicted shapes (±3 SDs). The grids are deformed in the direction of decreasing (left) and increasing (right) power and sociability, respectively.
values of 0.001 and 0.185. Predicted shapes are visualized for PC1 and PC2 for scores ±3 standard deviations of the trait variation on the associated axis (Fig. 3).

Cars of high “power” are relatively lower/wider and/or have more slitlike and/or laterally angled headlights and/or a wider, but less high, air intake. The spline reveals a vertical extension of the grille. Conversely, there is a vertical stretching with decreasing “power.” The windshield in these cars is relatively larger. Headlight shapes are also rather distinctive, shifting closer to the car’s midline. The grille is narrower, and the region between the grille and air intake is extended. The greatest lateral extension of the additional structures is shorter and closer to the actual air intake, which is expressed by the “pulling in” of the grid.

On PC2, in the direction of increasing “sociability,” there is some degree of widening and shortening of the car and an apparent shifting of the lateral-most points upward with respect to the headlights. The grille is enlarged and positioned relatively higher with respect to the headlights. The greatest lateral extension of the inner part of the air intake is shifted upwards. On the other hand, cars with large negative loadings have air intake slots whose greatest lateral extension is relatively lower, suggesting a rectangular rather than trapezoidal air intake; the outer parts point even further down.

Partial Least Squares Analysis

Partial least squares (PLS) analysis (Rohlf and Corti 2000; Streissguth et al. 1993) constructs mutually orthogonal sets of linear combinations of each set of variables (shape and trait averages) that covary the most between the two sets. The first pair of PLS axes accounted for 93% of the total cross-correlation (randomization test: $P<0.001$), the second PLS axes for less than 4% ($P=0.999$).

![Fig. 4 Shape-trait PLS analysis. The plots visualize ±2 SDs along the first pair of PLS axes. Displacements represent magnitudes of the individual traits associated with the related spline plot and can be read from left to right as: child–adult (1), male–female (2), friendly–hostile (3), submissive–dominant (4), angry (5), afraid (6), happy (7), surprised (8), open (9), agreeable (10), content (11), arrogant (12) and aroused (13)](image)
Combining geometric morphometrics with PLS analysis allows the visualization of the relationships (Fig. 4). The “displacement bar” at the top of each plot pair can be interpreted as the individual contribution of each trait to the combination of traits most correlated with shape. Thus, the car pictured on the left represents a childlike, female, friendly, submissive, not angry, afraid, happy, surprised, open, agreeable, not arrogant, and/or unaroused car. It gives a compact impression. The windshield becomes more prominent, the grille narrower. The extreme upper and lower edges of the headlights are close to the middle of the car. Additional lateral structures are close to the inner part of the air intake. The centers of the rearview mirrors are shifted upward. Just the opposite is true for cars that are rated as adult, male, hostile, dominant, angry, unafraid, unhappy, unsurprised, closed, disagreeable, arrogant, and/or aroused (Fig. 4, right).

Raters’ Preferences for Car Shapes

We regressed GPA-constructed shape variables onto the single variable “liking” (coded 0 to 100, average 40, range 20–55), explaining 11.5% of shape variation (1,000 permutations: $P=0.001$). Predicted geometries are given in Fig. 5. The cars that are “liked” are predicted to have a wide stance, a narrow windshield, and/or widely spaced, narrow headlights. The lateral-most points of the air intake are

![Fig. 5 Predicted shapes of cars for “liking” values of 0 (left), 40 (center—the average with the undeformed grid), and 80 (right)]](image)

Fig. 5 Predicted shapes of cars for “liking” values of 0 (left), 40 (center—the average with the undeformed grid), and 80 (right)

![Fig. 6 Subjects’ association of a face with the car. More than 60% of our subjects indicate seeing a face in at least 70% of the cars presented]](image)

Fig. 6 Subjects’ association of a face with the car. More than 60% of our subjects indicate seeing a face in at least 70% of the cars presented
shifted upwards, the grille is extended vertically. These attributes are very similar to those of “power” and, in fact, the association between “liking” and PC1 scores is significant (Kendall’s tau=0.312, P=0.006).

Raters’ Perception of Facial Features in Cars

As shown in Fig. 6, 32.5% of our subjects associated a human or an animal face with at least 90% of the cars. People were also asked to mark facial features in each car whenever and wherever they thought appropriate. All 40 subjects considered all 38 cars (N=1,518, as two were missing). They marked eyes in 75.2%, a mouth in 62.6%, a nose in 54.3%, and ears in 38.1% of the cases. Generally, the headlights were marked as eyes. The nose tended to be the grille or the emblem; the additional air intake slots, the mouth.

Discussion

Error management theory states that asymmetries in the recurrent costs of errors in inference can lead to the evolution of biases, even when these biases result in greater rates of inferential error (Haselton and Buss 2000). An overperception error in terms of processing artifacts as agents does no harm at all, whereas a single real encounter lacking that inference could be lethal. This effect probably forces us to interpret our world primarily in social terms. In this study we show that people act consistently with this assumption and that GM can be used as a valid tool for the reconstruction of such perceptive biases.

In our study, people generally agreed in their ratings. Thus, there must be some kind of consistent information that is being perceived in car fronts. However, a few traits lacked such agreement (disgusted, extroverted, sad, neurotic, and conscientious), possibly for several reasons. In humans, judgments of conscientiousness seem to be linked to dress style and extroversion to attractiveness (Albright et al. 1988)—qualities that might not be communicated in cars. Second, some traits are difficult to judge even in our conspecifics, such as disgust (Hess and Blairy 2001) and neuroticism (Borkenau and Liebler 1992).

The rating of car fronts was found to vary mainly along a single dimension which we identified as “power,” explaining 83% of trait variation. Perceived maturity had the greatest contribution to this vector, followed by the interpersonal attitudes of dominance, arrogance, anger, and hostility. A further component of high impact was masculinity.

Since we were not only interested in the perceptions per se but also in the corresponding car shapes, we performed shape regressions as well as a PLS analysis. The latter gives the shape that best matches a linear combination of the traits under consideration. The existence of a significant regression as well as a significant pair of PLS axes are further strong support for the consistent interpretation of car shape. Both approaches showed a highly similar pattern of covariation of shape and trait allocation and point to configurational analogies between car fronts and (human) faces.

On the large scale, the grids illustrate a shape change toward a larger windshield and a smaller car body in the direction of low “power.” This resembles the classic human (and, in the broader sense, mammalian) growth allometry pattern, with
infants having a relatively larger neurocranium and a smaller face than adults. Facial growth ceases in females at the age of 14 while males continue growing beyond the age of 18 (Ursi et al. 1993). There is no vertical elongation in the grid representing mature, masculine cars as seen in the growing human face, but presumably the raters were able to assess more of the 3D form than was finally captured by the 2D landmarks. In almost all cars scoring high in “power,” the hood is elongated horizontally and at least resembles the protruding adult lower face. These proportion shifts reflect what Pittenger et al. (1979) found when applying the cardioidal strain algorithm—a mathematical transformation simulating growth—to drawings of Volkswagen Beetle fronts and asking the participants for relative age attributions. Interestingly, the cardioidal strain transformation does not seem to model aging in all objects (cf. the remarks on armchairs and shoes in Mark et al. 1988). The pronounced lower car body relative to the windshield area further resembles the prominent chin reported for dominant-looking people (Buss 2004). We actually found that ratings for dominance, arrogance, anger, and hostility increase with “adulthood” and “masculinity.” Since the perception of biological forms is interlinked with the association of certain attitudes and behavioral stereotypes, we suggest that perceived age and sex drive the first PC (“power”). We are not aware of studies that explicitly test the representation difference for infants versus adults (it might be too obvious to test anyway), but we know that one attributes childlike traits to baby-faced people of all ages, perceiving them as less dominant and less strong (Keating et al. 2003). Likewise, along this same trajectory, women relative to men are perceived as soft and submissive (Ashmore and Tumia 1980). Masculinized male (and female) faces, on the other hand, obtain higher ratings in perceived dominance, masculinity, and age (Perrett et al. 1998).

As opposed to the large-scale changes described above, we will now discuss the more local deformations. Headlights become more angular in the direction of increasing “power” and appear to parallel what Brannigan and Humphries (1972) described as an angry frown (having the eyebrows drawn down, particularly at the inner ends). Thus, the association of hostility and arrogance is not surprising. Schematic faces with lowered eyebrows are also chosen as the more dominant ones (Keating et al. 1977). Massive eyebrow ridges are a testosterone-mediated masculine trait in the human face (Schaefer et al. 2005). The bigger grille might reflect the larger noses of men as compared with women (Enlow and Hans 1996).

Conversely, cars perceived as childlike, submissive, not arrogant, not angry, female, and friendly are characterized by headlights that have their upper edge maximum relatively closer to the midline, which looks similar to Brannigan and Humphries’s (1972) sad frown (eyebrows being drawn down at their outer ends) or sad eyebrow raise. It might reflect the inner brow raise frequently present in happy, sad, and fear expressions (Kohler et al. 2004). These are also exactly those attributes scoring high in the PLS analysis corresponding to a visualization of shape with the same headlight properties.

The second PC of our perception ratings “sociability” deviates from the first in that happiness, openness, and agreeableness have major contributions. These attributes are generally found to be amplified when people judge smiling persons (Otta et al. 1996) and remind of the warmth dimension assumed (along with competence) to be a universal dimension of social cognition (Fiske et al. 2007).
Shape regression, though not significant, shows a relative upward shifting of the lateral-most points of the air intake with increasing “sociability.” In this way, the car gives us a big smile.

The better our subjects liked a car, the closer it matched the shape characteristics corresponding to high values of “power” (PC1). Thus, people seem to like mature, dominant, masculine, arrogant, angry-looking cars. Shape regressions for the sexes considered separately (not included in this paper) look alike. In interpreting this finding, it is important to bear in mind that liking is a multifaceted concept. We can like somebody as a spouse, a one-night stand, a friend, an ally, etc. With regard to cars, this list might extend even further. It could well be that we favor a car not because we see an interaction partner but as a means of communication and maybe even manipulation. Atzwanger (1995) has shown that specific car designs do affect the lane-changing behavior of other drivers. Giving a mature, dominant, masculine, arrogant, and angry impression might therefore be desirable in the daily battles on the roads (crowded intersections, traffic jams).

Undoubtedly, what I “like” and what I “buy” are not necessarily the same things. However, such design considerations might facilitate the decision between otherwise equal opportunities.

On the other hand, we cannot rule out potentially intervening variables. Cars of high “power” also tend to be the more expensive, prestigious, high quality, of greater engine capacity, and probably also safer. But we can make inferences about two related aspects that could have mediated in impression formation: owner and brand stereotypes. We do not deny interdependencies, but one has to be cautious when considering the direction of causation. Do we judge the car the way we do because of our (maybe stereotyped) impression of its owner, or did the owner decide to buy this car because it communicates the desired characteristics? Did brand attributions override the perceived attributes of the car front being presented, or is BMW (for example) regarded as a dominant, male, etc., brand because the company has always built cars that have such a (facial) expression? Furthermore, the possibility that brand personality attributions have affected the characteristics rating can be dismissed. The Volkswagen New Beetle, Golf, and Passat are actually spread along the first principal component (PC 1), although they belong to the same brand. Also the two Citroëns, which are rather close to each other in price and engine capacity, are far apart along PC 1 (Fig. 2).

The idea of cars having faces is not new. This association can be found in scientific textbooks, as in Enlow and Hans (1996) and Coss (2003), in films (e.g., Walt Disney’s “Cars” [2006]), and in car descriptions on TV and in auto magazines. They refer to “almond eyes” (of a Citroën DS; Schirman 2006), Kindchenschema (Kerssenbrock 2005), or a smile (Juergens 2003). Catalogues of automobile accessories offer headlight covers (“eyebrows”), to give the car an “evil look” (Juergens 2003). Also, the results of this study suggest that humans are prone to see faces in cars. Not only did people consistently attribute characteristics to specific car shapes, they also agreed on the degree of “faciness” (Fig. 6, Table 2). Other indirect evidence is that, when asked, more than 60% of our subjects indicated seeing a face in at least 70% of the car fronts presented. Moreover, they marked eyes in 75%, a mouth in 63%, a nose in 54%, and ears in 38% of the cases. Eyes were marked at headlights in 98.4% of the eye-markings, which is consistent with the findings of
Erk et al. (2002). We are aware of not being able to distinguish whether our subjects have always perceived facial features in cars or whether they did so only because we asked them to look for them. However, support is evident in the striking importance of eyes, as found for real faces in eye-tracking studies (e.g., Henderson et al. 2001). Moreover, we recently conducted an eyetracking study ourselves and found a significance of headlights (and eyes) in attracting our gaze, even when subjects were asked to look for the mouth, the nose, or the ears (Windhager et al., submitted). Another hint comes from fMRI research. Erk et al. (2002) suggest that our brain processes cars in a similar way to faces because the cars activate the fusiform face area (but cf. Gauthier et al. 2000). The methodology of our study does not allow conclusions on the underlying processing mechanisms or the degree of overlap between face and non-face processing, but it could provide a starting point for the formulation of specific hypotheses to be tested with functional magnetic resonance imaging (fMRI) and electroencephalography (EEG).

It was a challenge to work with built structures because the single parts can be placed rather deliberately. Furthermore, there might be shape information that we have not captured through our landmarks but that still influences perception. Additional lateral structures are perceived as belonging to the mouth in some cases but not in others, thus constraining the interpretation. Moreover, the analyses treat all landmarks equally, but some might dominate particular analyses or guide perception—for example, the shape of the headlights might be more important in determining the rating than the size of the grille.

Let us now speculate on the reasons for cars’ appearance. It might be that we want our cars to express what we are or what we would like to be. On the other hand, their shapes might be a result of functional constraints—for example, the faster the car, the smaller (the more tilted) the windshield, and the “adult” resemblance might just be a coincidence.

This study was a first step to link the shape of car fronts and their constituent parts to trait attribution. Many questions remain. People might associate cars with an animal rather than a human face. The horizontal compression depicted in grids visualizing a dominant, aggressive car could give the impression of a crouching predator ready to attack. Preliminary investigation of sex differences suggests that there is a general pattern of automotive perception. The prospect for future research is to have a closer look at the sexes and at size, a characteristic we excluded from the present analyses. Furthermore, incorporating subjects who lack experience with our cars, brands, and media would allow even stronger conclusions.

With respect to practical applications, a tool for automobile designers to style cars according to a desired image could be derived. How the perception of car fronts affects our daily life (i.e., driving or pedestrian behavior) remains to be investigated. Does one change lanes and give way sooner when an “aggressive” car appears in the rearview mirror?

**Conclusion**

The aim of the present study was to investigate whether people tend to perceive the world primarily in a social way. We wanted to see whether people ascribe certain
traits to cars as they do to human faces, and if it is possible to extract the underlying shape information. Our main result was that people actually ascribe characteristics concordantly for most of the dimensions analyzed. The perception of car fronts was found to vary mainly along a single dimension comprising maturity, sex, and interpersonal attitudes, whereas emotions and personality traits pale in comparison. Applying geometric morphometrics, we show that distinct features in the car fronts correspond to different trait attributions. Thus, humans possibly interpret even inanimate structures in biological terms, which could have implications for driving and pedestrian behavior.

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