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Cross-ethnic assessment of body weight and height on the basis of faces

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ABSTRACT

Previous research has revealed a strong relationship between mere visual facial cues and body weight. They can be exploited to validly judge the weight of the human body. We tested to what extent observers are able to judge body weight and height on the basis of same-ethnicity and different-ethnicity faces. Caucasian and Asian observers saw Caucasian and Asian faces and estimated the person's weight and height – merely on the basis of greyscale photographs of the face. These height and weight estimates were influenced by ethnocentric specifics of familiar face proportion and face–body relationship. Own-ethnicity weight estimations showed higher accuracy than foreign-ethnicity estimations. Observers ignored the changed base-rate for weight of other-culture faces in a culture-egocentric fashion. Height judgments, in contrast, reflect a higher degree of sophistication. A bias toward the own, familiar body proportion was visible here, especially for Japanese observers—however, the height judgments showed that observers were able to incorporate the other-ethnicity height proportion to some extent.

1. Introduction

A stream of research (e.g., Coetzee, Chen, Perrett, & Stephen, 2010; Coetzee, Perrett, & Stephen, 2009; Schneider, Hecht, & Carbon, 2012) has revealed an interesting relationship between mere visual facial cues and body weight. Weight judgments of people of different populations were fairly accurate on the basis of frontal facial cues alone (Coetzee et al., 2009). The interpretation of weight judgments on the basis of facial photographs may, however, be problematic if the vantage point of the camera is not controlled. Judgments are profoundly susceptible to changes of viewing angle (Schneider et al., 2012).

In Western societies obese female bodies are judged to be less attractive (e.g. Swami & Tovee, 2008) and less healthy than normal-weight female bodies (e.g. Furnham, Swami, & Shah, 2006). In terms of face perception, Hume and Montgomerie (2001) showed that overweight women were judged to be less attractive than lower-weight women. Face preferences have been seen to be similar among different cultures (Cunningham, Roberts, Wu, Barbee, & Druen, 1995; Zebrowitz, Montepare, & Lee, 1993) and among people with different face processing abilities (Carbon, Gruter, Gruter, Weber, & Lueschow, 2010), revealing high intercultural and intergroup consensus, respectively. Yet, there are also findings of intercultural differences in preferred body shape and weight, as reported by Furnham and Baguma (1994). They showed that in some non-Western cultures, especially African, overweight female bodies are associated with attractiveness, which is in contrast to the general finding of underweight female bodies being judged to be more attractive than normal-weight bodies (Furnham & Baguma, 1994; Tovee, Reinhardt, Emery, & Cornelissen, 1998; Yu & Shepard, 1998).

According to body weight perception, Wardle, Bindra, Fairclough, and Westcombe (1993) revealed cross-cultural differences in body images: Asian women were less likely to describe themselves as too fat, were less dissatisfied with their own body size, and less likely to lose weight compared to Caucasian women. Additionally, average Asian women weigh less than Caucasian women. Furnham, Titman, and Sleeman (1994) and Re et al. (2011) showed that judgments relating to body shape can be influenced by mere exposure. Cross-ethnic differences in self-reports are believed to arise due to better access to ingroup versus outgroup information (Clement & Krueger, 2000).

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In sum, recent research reveals a strong relationship between visual facial cues and perceived body weight (e.g. Coetzee et al., 2010, 2009) as well as some evidence for cross-ethnic differences relating to body weight perception and preferences (e.g. shape). Accordingly, beside the fact that faces may not always provide valid cues to body weight (e.g. for changes in viewing angle see Schneider et al., 2012), one could expect that this information may be insufficient to validly predict body weight (and height) across different ethnicities.

Following this assumption, *familiarity* and *experience* with the facial morphology of another ethnicity seem to be an obvious explanation for differences in body judgments across various ethnicities. More precisely, differences in anthropometric proportions (body weight and height in relation to a specific facial morphology) between studied ethnicities should lead to differences in body value judgments. For instance, if the relative head width in relation to body height is different between two ethnicities, this should produce errors when judging a face of an ethnicity where this relation is different.

When generalizing this idea to body estimations, it could be expected that we use a familiar reference system (e.g. the familiar anthropometric face–body relationship) to make judgments about another ethnic group (with another anthropometric face–body relationship which is unfamiliar to us). Thus, comparative accuracy of judgments should also depend on the degree of *experience* and *familiarity* we have with another ethnicity (e.g. cross-ethnic frequencies of meeting people from other societies or the comparative number of residing people of another ethnic group in one's own country).

In the present study we investigated the cultural impact on estimated body weight and height by asking Caucasian vs. Asian observers to rate these variables based upon inspection of Caucasians and Asians faces. If the reference system for such judgments is ethnic-specific it may be biased toward the own anthropometric proportions. Own-ethnicity faces should produce more accurate judgments than other-ethnicity faces. For instance, if Asian faces are on average more rounded, the Caucasian observers who are unfamiliar with this fact should overestimate Asians weight. Thus, we also compared anthropometric data of facial morphology relative to average body weight and height across Germany and Japan, as provided by Farkas et al. (2005), to investigate this hypothesis.

2. Method

2.1. Participants

271 Observers participated in the experiment (146 Japanese, 100 female; $M = 19.1$ years, $SD = 2.0$, range 18–36 years and 125 German, 106 female; $M = 22.1$ years, $SD = 3.9$, range 18–42 years). Mean weight for German observers was 63.4 kg and for Japanese observers 53.5 kg. German observers had associated average heights of 170.0 cm, Japanese observers of 162.6 cm. Data from the Japanese sample were collected at the Ritsumeikan University Kyoto (Japan), and from German samples at the Johannes Gutenberg-University Mainz and the University of Bamberg (both in Germany). All participants were naïve to the aim of the study and were not familiar with the presented faces.

2.2. Materials and procedure

The material consisted of a paper-and-pencil questionnaire with 2 [model ethnicity] × 2 [model sex] × 3 [exemplars] = 12 (2 × 3 Japanese and 2 × 3 German) frontal greyscale photographs of human faces with a mean age of 24.0 years ($SD = 3.9$). Mean anthropometric measures for the persons depicted by these pictures were 76.3 kg and 177.3 cm (German faces; female: 71.9 kg and 173.7 cm, male: 80.6 kg and 181.0 cm) and 67.5 kg and 165.8 cm (Japanese faces; female: 56.0 kg and 159.5 cm, male: 79.0 kg and 172.0 cm). The stimuli were pseudo-randomized into four different orders, printed on hand-outs such that each page contained one photograph and the lines to fill in the estimated weight (in kg) and height (in cm). Each participant was randomly allocated to one of these four orders. For each face, one at a time, participants provided body weight (kg) and body height judgments (cm) before turning the page to the next face. The whole procedure lasted approx. 15 min.

3. Results

3.1. Anthropometric analysis

To test our first hypothesis that unfamiliar anthropometric proportions will lead to estimation biases, we analysed facial anthropometric data provided by Farkas et al. (2005) for Japanese and German people (see Fig. 1 and Fig. 2). We used ten anthropometric facial measurements. Orbits: ex-ex (biocular width), face: zy-zy (face width) and go-go (mandible width), nose: al-al (morphologic nose width) and labio-oral region: ch-ch (mouth width) (defined as frontal facial cues according to Farkas et al. (2005), see Fig. 1). Measures used to calculate lateral facial cues provided by Farkas et al. (2005): Head: tr-n (forehead height), face: tr-gn (physiognomic face height), n-gn (morphologic face height) and sn-gn (lower face height) and nose: n-sn (nose height) (defined as lateral facial cues according to Farkas et al. (2005)).

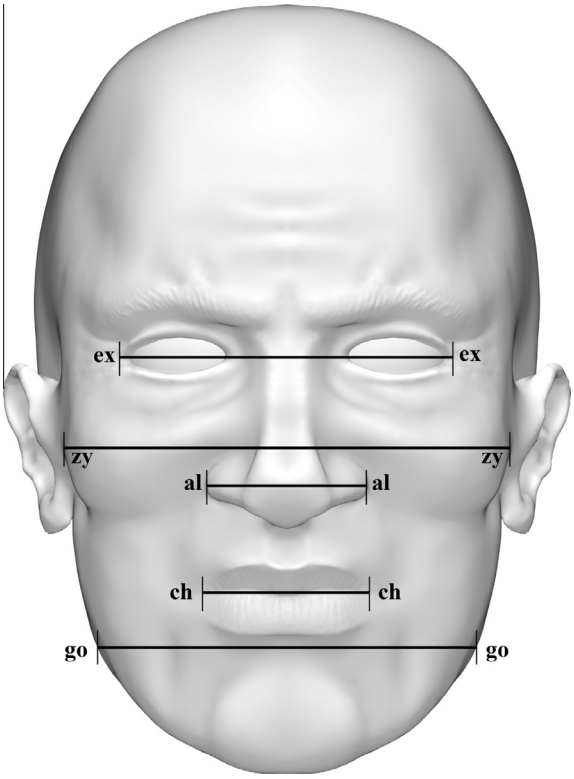

Fig. 1. Measures used to calculate frontal facial cues provided by Farkas et al. (2005): Orbits: ex-ex (binocular width), face: zy-zy (face width) and go-go (mandible width), nose: al-al (morphological nose width) and labio-oral region: ch-ch (mouth width).

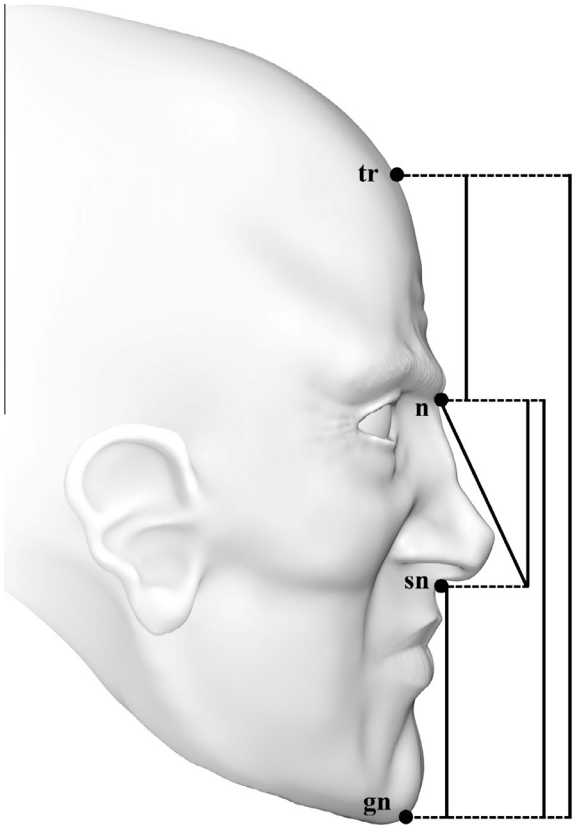

Fig. 2. Measures used to calculate lateral facial cues provided by Farkas et al. (2005): Head: tr-n (forehead height), face: tr-gn (physiognomic face height), n-gn (morphologic face height) and sn-gn (lower face height) and nose: n-sn (nose height).

Analysis of this data revealed significantly larger face widths (zy-zy), mandible widths (go-go) and larger morphological nose widths (al-al) for Japanese people (see Table 1).

Regarding the face–body relationship between both samples, Japanese people seem to have more brachycephalic head proportions, given their relatively lower body weight and height, compared to the German sample (for demonstration see Fig. 3). This is consistent with the population statistics of both nationalities that show lower body weight and height data for Japanese citizens (Ministry of Health, Labor & Welfare; Statistisches Bundesamt, 2011b).

Accordingly, to analyse the accuracy (estimation error) made by the observers, we analysed body weight/height judgments. Two-way mixed-design analyses of variance (ANOVA) on body

Fig. 3. Demonstration of differences in facial anthropometrics at the same body mass index (BMI). Example stimuli from the original questionnaire. (a) shows a female German face (b) a female Japanese face. Both faces had an associated BMI (= kg/m^2) of ≈19.0.

estimations with the between-subjects variable *subject nationality* (nationality of the observer) and the within-subjects variable *model nationality* (nationality of the shown face) were conducted.

3.2. Weight judgments

Analyzing the body weight judgments in general, German weight judgments (M = 70.7 kg) were significantly higher than Japanese judgments (M = 60.8 kg), F (1, 269) = 555.9, p < .0001, η_p^2 = .674, with a small but significant effect for *model nationality*, F (1, 269) = 19.41, p < .0001, η_p^2 = .067, whereby German faces (M = 65.9 kg) were judged to be heavier than Japanese faces (M = 64.7 kg). Regarding the accuracy of judgments, estimation errors (i.e. deviations of judgments from the actual anthropometric data as percentages) for weight showed excellent reliabilities across ethnicities (Cronbach's α), see Table 2.

An ANOVA for weight estimation errors revealed a significant effect of *subject nationality*, F (1, 269) = 568.3, p < .0001, η_p^2 = .679 ($M_{GermanObservers}$ = 0.20% estimation error and $M_{JapaneseObservers}$ = 13.54% estimation error, see Table 2). However, German observers slightly underestimated own-ethnicity faces (M = −6.28%) while tending to overestimate Japanese faces (M = 6.69%), see Table 2. Japanese observers tended to underestimate own-ethnicity faces (M = −7.31%) while they profoundly underestimated German faces (M = −19.76%), see Table 2.

We further found a significant effect for *model nationality*, with a higher estimation error for German faces, F (1, 269) = 1,241.2, p < .0001, η_p^2 = .822 ($M_{GermanFaces}$ = −13.02% estimation error and

Table 1
Differences between anthropometric measurements across Germany and Japan provided by Farkas et al. (2005). z-scores are two-tailed ($^{*}p \leqslant 0.05$, $^{**}p \leqslant 0.01$, $^{***}p \leqslant 0.001$).

Facial measurement	Germany		Japan		z-Score	
	M	SD	M	SD		
tr-n	68.1	7.5	61.8	7.2	0.886	
tr-gn	176.6	9.5	187.1	7.9	1.334	
n-gn	112.8	7.0	118.3	6.4	−0.862	
sn-sn	65.6	6.5	66.1	6.1	−0.082	
zy-zy	128.3	8.5	144.2	5.9	−2.716	**
go-go	94.6	8.6	116.5	7.0	−3.143	***
ex-ex	87.2	4.0	98.6	8.3	−1.376	
n-sn	51.7	4.5	55.1	5.0	−0.682	
al-al	32.5	2.5	37.7	2.5	−2.065	*
ch-ch	49.6	3.5	47.5	3.7	0.565	

Table 2
Average weight and height estimation errors (M_{error}) in percent with reliabilities (Cronbach's α) for German and Japanese observers (subject nationality) along German and Japanese faces (model nationality). Negative values indicate underestimation.

$Subject_{Nationality}$	$Model_{Nationality}$	M_{error}	SD	Cronbach's α
Weight estimation errors				
German	German	−6.28	4.38	0.997
German	Japanese	6.69	6.64	0.996
Japanese	German	−19.77	5.75	0.993
Japanese	Japanese	−7.32	5.34	0.998
Height estimation errors				
German	German	−1.34	1.53	0.989
German	Japanese	1.34	2.12	0.994
Japanese	German	−3.86	2.05	0.990
Japanese	Japanese	−0.47	1.45	0.994

$M_{JapaneseFaces}$ = 0.32% estimation error, see Table 2). However, this effect appears to be a result of the strong underestimation by Japanese observers. We did not find an interaction between *subject nationality* and *model nationality*, F (1, 269) < 1, p = .470, *n.s.*

3.3. Height judgments

Analyzing the body height judgments in general, German height judgments (M = 171.4 cm) were significantly higher than Japanese judgments (M = 167.7 cm), F (1, 269) = 145.1, p < .0001, η_p^2 = .350, with a significant effect for *model nationality*, F (1, 269) = 839.5, p < .0001, η_p^2 = 757, whereas associated height for German faces (M = 172.6 cm) was higher than for Japanese faces (M = 166.2 cm). Regarding the accuracy of judgments, height estimation errors along both ethnicities showed also high reliabilities (Cronbach's α), see Table 2.

A two-way mixed-design analysis of variance (ANOVA) on height estimation errors, with the same structure as for weight measures, was conducted to test height-specific hypotheses. We found a significant effect for *subject nationality*, F (1, 269) = 145.4, p < .0001, η_p^2 = .351 ($M_{GermanObservers} \approx 0\%$ and $M_{JapaneseObservers}$ = −2.17% estimation error, see Table 2). However, German observers slightly underestimated own-ethnicity faces (M = −1.34%) while tending to overestimate Japanese by the same value, see Table 2. Japanese observers tended to slightly underestimate own-ethnicity faces (M = −3.86%) while they were fairly accurate by estimating German faces (M = −0.47%), see Table 2.

Further analyses revealed a significant effect for *model nationality*, F (1, 269) = 566.8 p < .0001, η_p^2 = .678, ($M_{GermanFaces}$ = −2.6% estimation error and $M_{JapaneseFaces}$ = 0.44% estimation error, see Table 2). Interestingly, we found a very slight, but significant interaction between *subject nationality* and *model nationality*, F (1, 269) = 7.8, p = .470, η_p^2 = .028, with the difference between height estimation errors related to German vs. Japanese faces being higher for Japanese observers compared to German observers.

4. Discussion

In the present study we assessed whether observers use an ethnicity based heuristic when judging human body weight (and height) from the mere inspection of a person's face.

Several studies (e.g. Coetzee et al., 2010, 2009; Schneider et al., 2012) investigated facial morphology and the relationship to the respective body weight. Importantly, estimations were astonishingly good on the basis of facial cues alone (Coetzee et al., 2010, 2009). However, beside the fact that in some cases (e.g. the change of perspective, Schneider et al., 2012), mere facial cues seem to be insufficient to validly predict the body weight of an associated face, a stream of research revealed strong cross-ethnicity differences relating to body preferences (e.g. Furnham & Baguma, 1994; Furnham et al., 2006; Swami & Tovee, 2008; Tovee, Maisey, Emery, & Cornelissen, 1999; Tovee, Swami, Furnham, & Mangalparsad, 2006; Tovee et al., 1998). Thus, we expected such an impact of ethnicity on the perception of body weight and height. On the one hand, it seems to be an obvious explanation that an ethnicity with brachycephalic head proportions and a comparatively lower body weight and height, should underestimate the body weight of an ethnicity with dolichocephalic head proportions with a comparative higher body weight and height. On the other hand, we expected that familiarity and experience with ethnicity-specific body proportions could be used as baseline (or reference system) for further body judgments. For instance, the experience of heavier and taller body proportions should lead to comparatively higher body value estimations.

Accordingly, judgments of German observers were significantly higher than body judgments of Japanese observers, a finding that supports our hypothesis insofar as both, our German sample as well as the German population in general was heavier than the Japanese sample and population. Regarding the head proportions provided by Farkas et al. (2005) for German vs. Japanese people, our analysis revealed significant differences between facial measurements defining the facial width. Thus, Japanese faces seem to have more rounded and broad (brachycephalic) head proportions than typical Germans.

Concerning the accuracy of body judgments, Japanese observers profoundly underestimated the weight associated with German faces, while providing rather accurate own-culture body weight judgments (with a relatively small estimation error). German observers tended to overestimate associated body weight for Japanese faces, whereas they also underestimated body weight for German faces. The first result might be interpreted as a bias toward familiar and typical weights and heights, the second result might be interpreted as a bias toward an ideal, but not the average of the regarded population or experiences. Particularly Japanese observers tended to make an estimation error towards the respective ethnicity-specific face–body proportions. The relatively small estimation error of German observers compared to the Japanese, could be also explained by a higher familiarity with Japanese face–body proportions due to the comparatively large number of Asians residing in Germany (approx. 1% of the total population in Germany) as opposed to the small number of Germans residing in Japan (approx. 0.05% of the total population in Japan) (Ministry of Internal Affairs & Communications, 2012; Statistisches Bundesamt, 2011a).

These findings are in accordance with findings that human judgments appear to be strongly influenced by simple heuristics based on reference systems with which the persons are familiar (Carbon, 2007). Relating to judgments about the human body weight, we have a better representation of face–body proportions of our own ethnicity, while we tend to use familiar proportions as a baseline for foreign-ethnicity judgments. Furthermore, analysis of anthropometric data supports the hypothesis that a simple (subjective) mismatch of face–body proportions (e.g. rounder face and comparatively lower body weight/height) could lead to a significant estimation error.

In sum, this study underlines previous findings (Coetzee et al., 2010, 2009; Schneider et al., 2012) regarding the strong relationship between facial cues and body relations. However, the ability to exploit facial cues seems to rely on a reference system that is specific to the ethnicity with which one is most familiar. Body estimations on the mere basis of facial cues are influenced by ethnocentric specifics of familiar face proportion and face–body relationship. This is plausible when taking into account that until the current age of globalization, such ethnocentric reference systems akin to simple heuristics have provided accurate estimates.

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