A man's face reveals his body height:
A GMM approach to ontogenetic and static allometry

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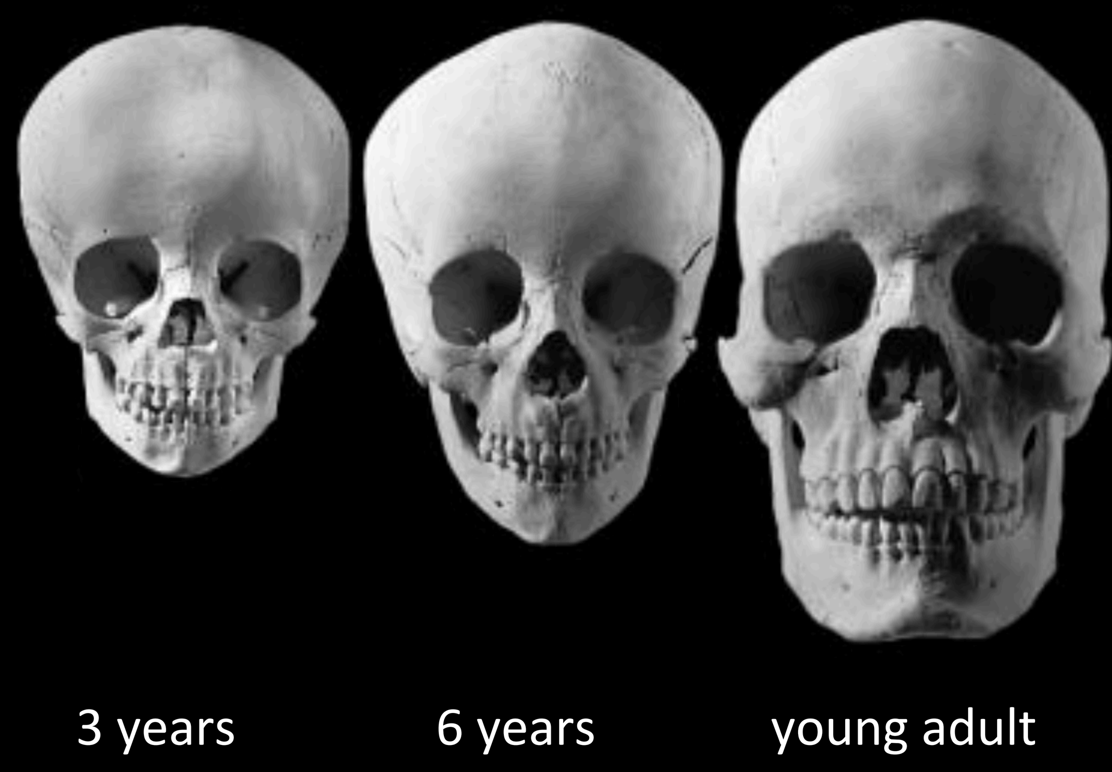

Figure 1. Change in facial proportions across age.
In line with the model of a craniocaudal maturity gradient, structures grow proportionally more and for a longer period of time the further they are from the neurocranium: infants have a relatively larger forehead and a smaller mid-face and chin as compared to adults. (modified from White et al. 2012)

Objective

Numerous studies investigated the role of body height in inter- and intrasexual selection (e.g., Courtiol et al. 2010, Pawlowski et al. 2000). Recently, also perceived facial cues to body height were found to relate to male attractiveness (Re & Perrett 2012). However, which facial features actually change with body height remains unclear.
We hypothesized that being taller is associated with facial features of extended growth and maturity (Figure 1), and hence, will also be perceived as socially dominant.

Material & Methods

Standardized frontal photographs of 19 boys (6–11 years) and 25 men (17–33 years) were collected together with body height and other anthropometric measurements in Austria. Sixty-nine landmarks and semilandmarks were then digitized on each facial photograph in order to assess the association of facial shape and body height (Windhager et al. 2011 for definitions).
Furthermore, 40 women (19–27 years) rated facial photographs of 20 men for body height (in cm) and for dominance.
The analyses were conducted in PASW, Mathematica, and the tps series by F. J. Rohlf.

Results

The ontogenetic shape regressions are very similar (Figure 2, left column) and explain between 20% and 24% of facial shape variation (p < 0.001; 1,000 permutations). This reflects the high correlation between face size (centroid size, CS), body height, and age during ontogeny (the pairwise correlation coefficients range from 0.84 to 0.92). In adult men, face size is no longer significantly associated with facial shape in our sample (3% expl. var., p= 0.76), whereas body height and age account for 8% and 7% of their shape variation, respectively (p < 0.001 each).
In both (ontogenetic and adult) samples, increasing body height is associated with a relatively longer and wider lower face (Figure 2 and Figure 3). Also the nose is longer. The lips are thinner, and the eyes appear to be smaller with lower and flatter eyebrows. With regard to perception, we identified a relatively strong, significant correlation between perceived body height (from the face alone) and the attribution of dominance (Pearson r= 0.53, p= 0.015, n= 20, Figure 4), but not between actual body height and attributed dominance (Pearson r= 0.33, p= 0.162, n= 20).
The Pearson correlation coefficient between actual and perceived body height was 0.47 (p= 0.035).

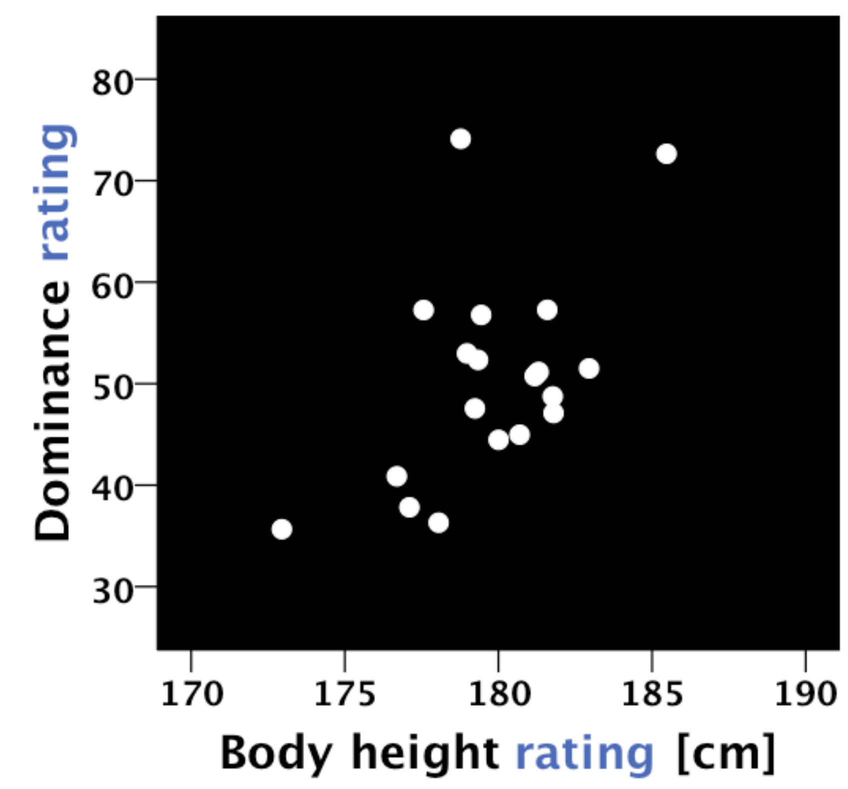

Figure 4. Perceived body height and dominance (n= 20 adult faces). Participants estimated body height (in cm) and rated dominance on a continuous scale, ranging from submissive (0) to dominant (100). Both variables were averaged for each face. The positive correlation between perceived body height and dominance confirms the results of Re et al. (2013) obtained from artificially manipulated faces and abstract height ratings.

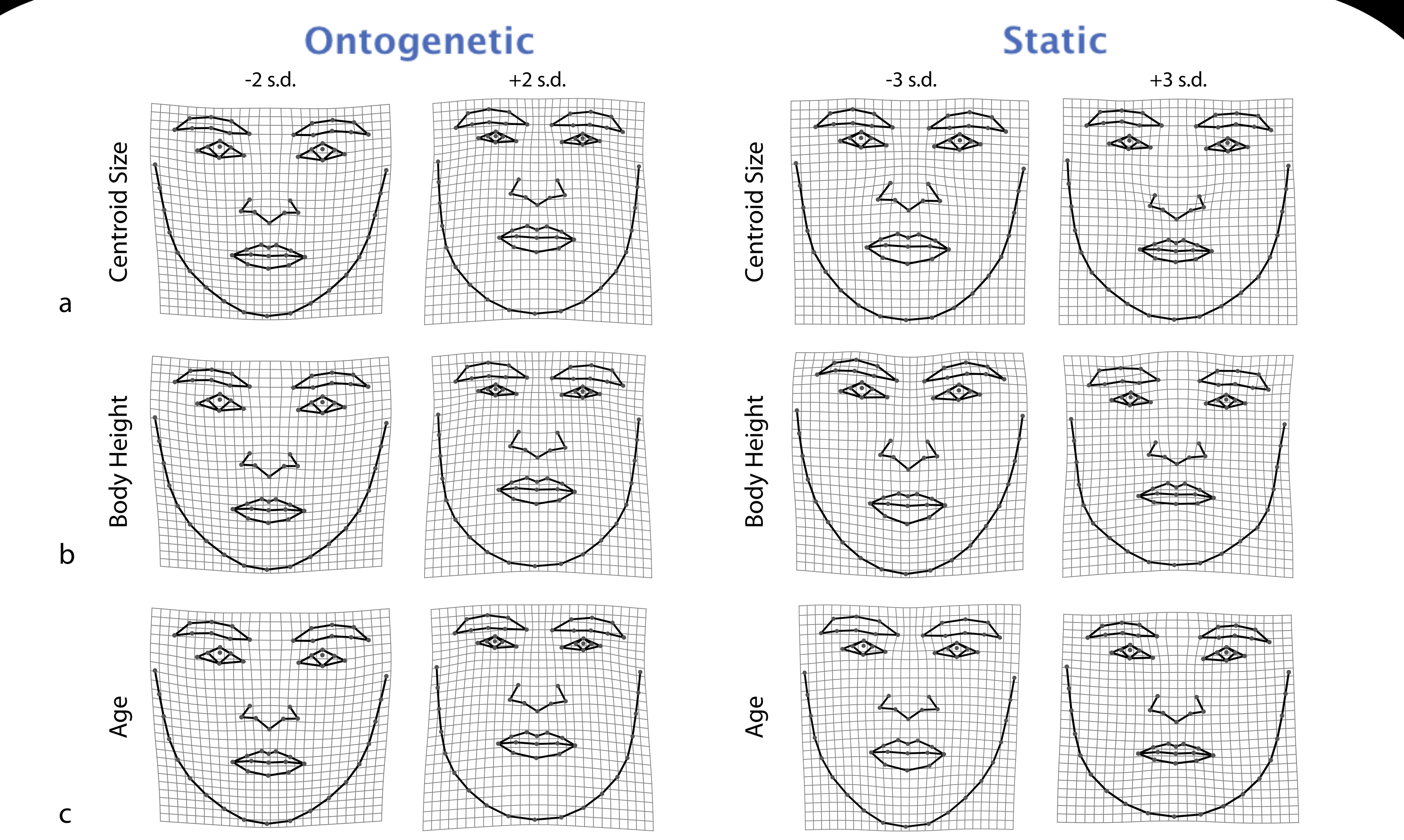

Figure 2. Visualization of the ontogenetic and static shape regressions (n= 19 boys and 25 men).
(a) Facial allometry estimated via regressions of face shape on ln CS in the full ontogenetic sample (ontogenetic allometry) and in the subsample of adults (static allometry). The displayed grids are deformations from the mean shape to shapes corresponding to –2 standard deviations (s.d.) and +2 s.d. of centroid size. (b) Regression of face shape on body height in the full sample and in adults only. (c) Regression of face shape on age in the full sample and in adults.
The ontogenetic regressions are very similar. The static regression of shape onto body height to some degree resembles the ontogenetic pattern, but the static regression on age seems to reflect another process: aging as opposed to growth.

Figure 3. Shape regression onto body height in adult men (n= 57 men).
The male average shape, corresponding to a 182 cm tall man (middle), was deformed towards minus 4 standard deviations (153 cm, left panel) and plus 4 standard deviations of body height (211 cm, right panel).
The taller the men, the relatively larger was their lower face, the thinner their lips, the lower were their eyebrows, and the smaller their eyes. The shape estimates are depicted as unwarped-and-averaged photographs using tpsSuper by F. J. Rohlf. They were then scaled according to facial size, as estimated from the regression onto log centroid size.

Conclusions

Our results suggest that there are reliable shape cues to body height in the male face with taller men exhibiting more mature facial features. In the past, stimuli were often isometrically "standardized" for facial size, yet, we showed, that they still contain (shape) information about size. This way, allometry might operate as confound in studies of perceived facial masculinity and dominance, competence judgments, and mate preferences.
Geometric morphometrics, however, enables us to disentangle some of the factors relating to facial shape variation and therefore has the potential to contribute to an evolutionary understanding of the biology behind common sense snap judgments.

An elaboration of this topic is currently in press in *Hystrix*.

References

Courtiol et al. 2010. *Evolution* 64-8: 2189–2203; Geraedts et al. 2011. *Horm Res Paediatr* 75: 213–219; Pawlowski et al. 2000. *Nature* 403: 156;
Re & Perrett 2012. *PAID* 53: 901–906; Re et al. 2013. *Evol Psychol* 11: 89–103; Schaefer et al. 2009. *Biol Theory* 4: 98–106;
White et al. 2012. *Human osteology*. Burlington (MA): Elsevier; Windhager, Schaefer, Fink. 2011. *Am J Hum Biol* 23: 805–814.

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