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Shape Differences Between the Faces of Homosexual and Heterosexual Men

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Abstract Previous studies have shown that homosexual men differ from heterosexual men in several somatic traits and lay people accurately attribute sexual orientation based on facial images. Thus, we may predict that morphological differences between faces of homosexual and heterosexual individuals can cue to sexual orientation. The main aim of this study was to test for possible differences in facial shape between heterosexual and homosexual men. Further, we tested whether self-reported sexual orientation correlated with sexual orientation and masculinity–femininity attributed from facial images by independent raters. In Study 1, we used geometric morphometrics to test for differences in facial shape between homosexual and heterosexual men. The analysis revealed significant shape differences in faces of heterosexual and homosexual men. Homosexual men showed relatively wider and shorter faces, smaller and shorter noses, and rather massive and more rounded jaws, resulting in a mosaic of both feminine and masculine features. In Study 2, we tested the accuracy of sexual orientation judgment from standardized facial photos which were assessed by 80 independent raters. Binary logistic regression showed no effect of attributed sexual orientation on self-reported sexual orientation. However, homosexual men were rated as more masculine than heterosexual men, which may explain the misjudgment of sexual orientation. Thus, our results showed that differences in facial morphology of homosexual and heterosexual men do not simply mirror variation in femininity, and the stereotypic association of feminine looking men as homosexual may confound judgments of sexual orientation.

Keywords Geometric morphometrics · Homosexuality · Facial shape · Sexual orientation

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Introduction

Attributions of Sexual Orientation and Its Mechanisms

Classifying the physical appearances of unknown people helps us to navigate the social world. As they are prominently displayed, facial traits play a particularly important role in social perception. Facial appearance influences our perception of broad social categories, such as age and sex (Bruce & Young, 1998), and it can provide cues to other, more subtle personality qualities such as extraversion or aggressiveness (for review, see Zebrowitz, 1997). During the last decades, some researchers have focused on less obvious categories, such as sexual orientation.

It is commonly believed that gay people are especially capable of recognizing each other on first sight. This is most likely based on various aspects of nonverbal behavior, including eye gaze, which can serve as a deliberate cue of sexual interest (Nicholas, 2004; Shelp, 2002). Also, it has been shown that intentionally controlled traits, such as hairstyle, might serve as a sign of male sexual orientation (Rule, Ambady, Adams, & Macrae, 2008). Nevertheless, recent research shows that sexual orientation can be accurately judged on the basis of rather involuntary facial cues (Ambady, Hallahan, & Conner, 1999; Lyons, Lynch, Brewer, & Bruno, 2013). It was shown that homosexual men were perceived as closer to the homosexual end of the heterosexual–homosexual continuum than heterosexuals. This was based on stimuli from both short video clips and still photos, though more accuracy was obtained in judgments based on behavioral videos than static photos (Ambady et al., 1999). Furthermore, accurate judgments were made as quickly as 50 ms and the accuracy did not improve with the length of the exposure (Rule & Ambady, 2008). This indicates that even a very short exposure to facial photographs is sufficient to infer the sexual orientation of unknown persons. It was also found that isolated facial cues, such as characteristic posturing around the mouth and eye area, provided sufficient information to enable above-chance accuracy in attributing sexual orientation (Rule et al., 2008).

Besides facial appearance, previous studies tested the role of vocal and other behavioral cues in sexual orientation attribution and it was found that listeners could distinguish between the speech of homosexual and heterosexual targets (Gaudio, 1994; Linville, 1998; Rieger, Linsenmeier, Gygax, Garcia, & Bailey, 2010), observers accurately judged sexual orientation from short video-clips of walking style (Johnson, Gill, Reichman, & Tassinary, 2007; Rieger, Linsenmeier, Gygax, & Bailey, 2008), and, in one study, sexual orientation was accurately judged from video clips that were only 1 s in length (Ambady et al., 1999). It was also shown that, to some degree, such attributions work cross-culturally (Rule, Ishii, Ambady, Rosen, & Hallett, 2011; Valentova, Rieger, Havlicek, Linsenmeier, & Bailey, 2011). In general, these studies have shown that homosexual men are accurately rated according to their faces and behavioral display across cultures although individuals more accurately rate the sexual orientation of people from their own country than those from others, and individuals from countries where homosexuality is less accepted were more prone to rate the targets as heterosexual. Further, two other studies showed that sexual orientation can be inferred from still photographs of the entire clothed figure (Ambady et al., 1999; Rieger et al., 2010). Moreover, it was found that voluntary concealment of nonverbal behavior connected to sexual orientation is possible only to a small degree (Sylva, Rieger, Linsenmeier, & Bailey, 2010). In this study, homosexual men were asked to voluntarily conceal behaviors that might reveal their sexual orientation and, the more demanding the experimental situation was, the less homosexual men were able to conceal nonverbal signs of their sexual orientation.

Thus, facial appearance, body movement, and paraverbal speech patterns seem to contain relevant information about the sexual orientation of unknown individuals. Only a few studies examined the possible mechanisms of attribution of sexual orientation based on unintentional cues. It was argued that atypical sex traits might serve as cues to sexual orientation (Rieger et al., 2010). Moreover, specific features of walking style (e.g., swagger and sway) and body morphology typical for heterosexual persons of the opposite sex were associated with homosexual individuals (Johnson et al., 2007). Similarly, home-made videos of homosexual men and women as recorded during their childhoods and standardized videos recorded at the time of the experiment were rated as more gender nonconforming than comparable stimuli from heterosexual targets (Rieger et al., 2010). Interestingly, voice pitch, which differs between males and females, is not associated with male sexual orientation (Gaudio, 1994). Nevertheless, there are other sex dimorphic speech patterns, such as formant frequency, that differ between gay and heterosexual men (Pierrehumbert, Bent, Munson, Bradlow, & Bailey, 2004; Rendall, Vasey, & McKenzie, 2008). After behavioral display and speech patterns, feminine male faces receive higher ratings of homosexuality than masculine faces (Dunkle & Francis, 1990; Freeman, Johnson, Ambady, & Rule, 2010). Recently, it has been reported that sex-atypical facial features are employed in attribution of sexual orientation of men and women alike (Lyons et al., 2013). This similarly applies to the inference of sexual roles (i.e. tops/bottoms) in male homosexuals (Tskhay & Rule, 2013). Moreover, faces that were digitally manipulated to show sex inverted traits, such as shape or texture, were reliably perceived as homosexual (Freeman et al., 2010). To summarize, people use atypical sex traits in facial appearance, body movements, and voice to infer the sexual orientation of unknown individuals.

Morphological Variation Among Homosexual and Heterosexual Men

Research on the mechanisms of the perception of sexual orientation has so far been focused on traits that serve as markers of sexual orientation. Nevertheless, there is another line of empirical evidence which shows that, besides their preferences of sexual partners, homosexual and heterosexual individuals also show other psychobiological differences. As for anatomical and morphological differences, homosexual men show female-like patterns in sex dimorphic brain regions, such as the hypothalamus (LeVay, 1991), anterior commissure (Allen & Gorski, 1992), or corpus callosum (Witelson et al., 2008).

Further, compared to heterosexuals, homosexual men tend to be shorter and lighter and they also have shorter long bones (Bogaert & Blanchard, 1996; Martin & Nguyen, 2004). Atypical sex development in homosexual individuals is also supported by studies showing sex atypical patterns in 2D:4D ratio (e.g., McFadden et al., 2005; however, for a meta-analysis which did not support 2D:4D differences between homosexual and heterosexual men, see Grimbos, Dawood, Burriss, Zucker, & Puts, 2010). Some of these traits develop during the prenatal or perinatal period under the influence of sex hormones and are thus discussed in relation to the etiology of sexual orientation. In short, it is thought that atypical levels of male sex hormones (especially lower levels of testosterone) during prenatal development lead to a development of sex-atypical traits, including morphological or cognitive traits, and also sexual preferences of individuals of the same sex (for review, see LeVay, 2010).

To summarize, these studies suggest that, on average, homosexual individuals show behavioral, psychological, and morphological traits that are in some ways similar to heterosexual individuals of the opposite sex. Nonetheless, most of the reported morphological differences are not perceivable (e.g., brain regions) or are unknown to most people (e.g., hair whorl) (Klar, 2004) and thus cannot be utilized in sexual orientation judgments.

Goals of the Current Study

As reported above, facial appearance provides cues to sexual orientation to unknown people and we therefore hypothesized that homosexual and heterosexual individuals also differ in their facial morphology. In contrast to the previous research focusing on facial traits through which sexual orientation was *perceived*, in this study we focused on facial traits through which sexual orientation is *expressed*. In other words, the aim of the current study was to determine if homosexual and heterosexual men differ in their facial morphology as measured and analyzed using the method of geometric morphometrics. Since atypical prenatal hormonal action may lead to sex-atypical development, one may predict that facial features in homosexual men would show rather sex-atypical, i.e., feminine traits. In Study 1, we thus examined possible differences between facial photos of homosexual and heterosexual men in their facial constitution. In Study 2, we examined the effect of self-reported sexual orientation on judged sexual orientation and masculinity–femininity from facial pictures.

Study 1

Method

Participants

The sample consisted of 40 homosexual (M age = 24.0 years; *SD* = 4.1) and 40 heterosexual (M age = 23.0 years; *SD* = 3.4) men, all of them of Czech ethnicity and Caucasian appearance. Participants were recruited via three main ways: Internet banners advertising the study were administered in five major Czech gay-oriented web pages, leaflets were distributed among five gay-oriented bars and clubs in Prague, and the first author advertised the research during an interview on a radio program for the Czech gay and lesbian community. Sexual orientation was not mentioned as a condition for the study in any of these sources so as not to discourage target participants. We only advertised the broader goal of the project, which was the investigation of partner preference. By these methods, 25 homosexual participants were recruited.

Fifteen homosexual participants were recruited by the snowball method through the social networks of the first author. In particular, an email was sent to both homosexual and heterosexual colleagues, friends, and students with the same information as was advertised in banners and leaflets asking them to spread the information further. When using these methods, we announced that, for purposes of this study, we required men from 18 to 35 years old, of any sexual orientation. Thus, we put no stress on the information about sexual orientation, but did let the potential participant know that we were not only seeking heterosexual persons. By this method, a majority of the heterosexual participants were also recruited. Another 15 heterosexual men were recruited by the same leaflets distributed at Charles University in Prague.

We attempted to match the samples in basic demographic data and the difference in age between these two groups was not significant $t(77) = 1.24$. Participants were asked to indicate their sexual orientation on a 7-point Kinsey scale ("Please indicate your sexual orientation on a 7-point scale, where 0 = sexual orientation aimed exclusively toward women, 7 = sexual orientation aimed exclusively toward men, and 3 = sexual orientation aimed at both, men and women, i.e., bisexuality"). Participants were also asked to use 7-point scales to indicate their sexual behavior during adolescence, adulthood, and the last year, as well as sexual preferences during adolescence, adulthood, and the last year. As nobody indicated points 2–4 on any of the Kinsey scales, only men indicating exclusive or nearly exclusive sexual preferences and behaviors toward either women (0 or 1 on the 7-point Kinsey scale) or men (5 or 6) participated in the study. All participants were reimbursed for their participation with 300 CZK (17 USD).

Measures

Facial Stimuli Preparation All targets were asked to remove facial jewelry and earrings and were instructed to adopt a neutral facial expression (as if they were on an elevator or listening to a lecture). To facilitate access to all facial parts during the geometric morphometric analyses, all targets were asked to use a provided black hair band to remove hair from the forehead. The portraits were taken using a Canon 350D camera with the focus Canon EF 50/1.8 II under standard conditions from a distance of 1.5 m.

Geometric Morphometrics There were 69 landmarks, including 36 semi-landmarks on each of 80 facial portraits, for a total of 11,040 2D coordinates. These coordinates were analyzed with use of geometric morphometric methods. The individual 2D landmarks were placed into mutually corresponding positions on the photographs of investigated objects. TpsDig, ver. 2. 14 (Rohlf, 2009a) software was used for this purpose. Similarly, the semi-landmarks were depicted along the outlines so that their number corresponded across individual objects. Fixed landmarks describe coordinates on each specimen that are anatomically (or at least geometrically) homologous while sliding landmarks (semi-landmarks) serve to denote curves and outlines. For example, the most lateral point on the zygomatic arch (zygion) represent typical landmark points whereas the face outline between the left (and right) zygion and the most inferior point of the mandible in the midline (gnathion) may illustrate a curve suitable for depiction of semi-landmarks. The exact locations of landmarks and semi-landmarks on male faces were adopted from Fink et al. (2005), Schaefer et al. (2006), Kleisner, Kočnar, Rubešová, and Flegr (2010), Kleisner, Příplatová, Frost, and Flegr (2013), and Třebický, Havlíček, Roberts, Little, and Kleisner (2013). All landmark (and semi-landmark) configurations were superimposed by generalized Procrustes analysis (GPA), implemented in TpsRelw software, ver. 1.46. Superimposition by GPA removes variation that may be attributed to differences in position, rotation or size of the individual objects (faces). What remains after GPA is the "pure" shape variation, such that morphological differences among objects that have not been caused by differences in their position, rotation or size may be analyzed by subsequent multivariate statistical methods.

To observe shape variation among the landmark data configurations of all individuals, the principal component analysis (PCA) was carried out in TpsRelw, ver. 1.46. (Rohlf, 2008) on the weight matrix (including the uniform component), which resulted from the thin-plate spline transformation of landmark data (Bookstein, 1991; Zelditch, Swiderski, Sheets, & Fink, 2004). The PC scores for the objects of the first 25 axes describing 97 % of total variation were used to test the shape differences between a priori groups as defined by self-reported sexual orientation. This was performed by the linear discriminant analysis and by the nonparametric two-group permutation test on Mahalanobis distance with 10,000 permutations, implemented in PAST, ver. 2.01 (Hammer, Harper, & Ryan, 2001). To visualize the shape variation associated with sexual orientation, GPA shape coordinates were regressed onto discriminant scores using multivariate regression in which shape coordinates represented the dependent variable and discriminant scores the independent variable (conducted in TpsRegr, ver. 1.36) (Rohlf, 2009b). Shape regressions were displayed by thin-plate splines as deformation from the overall mean landmark configuration.

To evaluate the effects of an overall bilateral asymmetry on differences between facial morphospace of homosexual and heterosexual men, the face shapes were analyzed using the PCA-based decomposition of symmetric and asymmetric variation (Kolamunnage & Kent, 2003; Mardia, Bookstein, & Moreton, 2000; Savriama & Klingenberg, 2011). A mirrored set of landmark configurations was established by their reflection along the axis of symmetry and subsequent relabeling of symmetrically corresponding landmarks (Klingenberg, Barluenga, & Meyer, 2002). A PCA of the combined original and reflected/relabeled dataset separated individual principal components of symmetric variation from the components of asymmetric shape changes (Kolamunnage & Kent, 2003; Savriama, Neustupa & Klingenberg, 2010). The relative proportion of bilateral asymmetry was assessed by summing the proportions of variance spanned by all the axes that describe asymmetric variation for individual groups. The PCA-based decomposition of symmetric and asymmetric variation relies on summing the percentages of explained variance of axes that span either symmetric or asymmetric variation. By definition, the entire set of PC axes describes all the morphological variation captured by our morphometric analysis. Therefore, decomposition of all the axes in two groups—symmetric and asymmetric axes—effectively evaluates the proportions of these two different patterns of morphological variation in the human face. The significance of differences in amount of relative asymmetric variation between sexual-orientation groups was assessed by a permutation routine in R, ver. 2.3.1. (R Core Development Team, 2009). The entire set of analyzed faces from both groups (80 original and 80 reflected/re-labeled configurations) was permuted and randomly divided into two groups of the same sizes as the original sexual orientation datasets. The GPA and PCA of these groups were conducted using the *shapes*, ver.1.0.9 module of R (Dryden & Mardia, 1998) and the amount of asymmetry was computed from individual principal components. The difference in relative asymmetry between groups was then calculated. This procedure was repeated 10,000 times and the original differences between the relative asymmetry levels of the sexual orientation groups were compared to a set that simulated the null hypothesis that the asymmetry did not differ by more than chance. All p values were conducted as two-tailed.

The qualitative evaluations of the morphological differences between the studied groups were based on the interpretation of thin-plate spline deformation grids that represent statistically supported landmark configurations estimated by shape regressions. This appraisal was independently done by one of the authors (K.K.), who performed all the geometric morphometrics analyses, and by an experienced physical anthropologist who was blind to the purpose of the study. The written verbal descriptions of both experts generally agreed on qualitative interpretations of the thin-plate spline deformations (e.g. both of them wrote that the shape of the oral cleft was concave in the heterosexuals compared to the convex cleft in homosexuals).

Results

Self-reported sexual orientation significantly classified the shape variation of male faces delineated by landmark configuration into two groups (Hotteling's T2, $p = .006$; 82.5 % of correctly classified individuals). In addition, the two-group permutation test of the shape data also rejected the null hypothesis of no association between facial shape and self-assessed sexual orientation ($p = .006$; Mahalanobis distance = .22). The qualitative appraisal of the thin-plate spline deformations of shapes characteristic for individual self-reported sexual orientation revealed notable differences in lateral compression (or dilations) in the regions of the mouth, nose, and space between eyes and mouth along the bilateral axis (Fig. 1). In contrast to the homosexual sample, the estimated figure for the heterosexual sample showed a larger nose and a shorter distance between the nose and mouth (i.e., shorter philtrum, the medial depression between the nose and upper lip bordered by ridges). We also observed a longer distance between eyes and mouth (i.e., distance between pupils and the medial center of the mouth). Further differences were observed in the shape of the mouth. In the heterosexual sample, the corners of the mouth orient upwards and the shape of the oral cleft was concave while in the homosexual sample the corners of the mouth oriented downwards and the shape of the oral cleft was convex. Finally, there was a notable difference in the shape of the chin. The heterosexual sample was characterized by an oval shape of the chin contrary to the rounded and wider chin of the homosexual sample.

The PCA of the combined original and reflected/relabeled landmark configurations of individual groups yielded 16.3 % of relative asymmetric variation for heterosexual and 13.7 % for homosexual male datasets. However, this difference of 2.6 %, which illustrated a slightly higher proportion of bilateral asymmetry in shape variation of heterosexual men, was not significant in a randomization test with 10,000 permutations.

Study 2

Method

Participants

The sample consisted of 33 (M age = 23.9 years; $SD = 4.5$) homosexual and 33 (M age = 22.4 years; $SD = 2.8$) heterosexual men from the total sample of the first study (chronologically, targets for this study were recruited first, so there were fewer targets than in Study 1). There was no significant difference in age between these two groups $t(65) = 1.61$.

Procedure

Forty female (M age = 21.3 years, $SD = 2.9$) and 40 male (M age = 23.2 years, $SD = 4.7$) students from Charles University in Prague took part in the rating session. All raters were recruited at the foyer of the main building of the Faculty of Humanities among students passing by. They were asked to participate anonymously in a study on male appearance, to rate male facial photos for masculinity and sexual orientation. The raters were not paid for their participation. All ratings took part in a quiet seminar room. Each participant was informed that all facial images were male, and they were instructed to rate sexual orientation on a scale from 1 to 7, with 1 indicating that the individual looked very heterosexual and 7 indicating a very homosexual appearance. For ratings of masculinity–femininity, raters were instructed to rate the faces on a 7-point scale with 1 indicating a masculine or male-like appearance and 7 indicating a feminine or female-like appearance. To avoid carry-over effects, each rater assessed only one parameter. In particular, 20 female and 20 male raters assessed masculinity–femininity while another 20 female and 20 male raters assessed sexual orientation. Image ratings were carried out on a 15-in. laptop screen with 1,280 × 800 pixel resolution using software Rater developed by L. DeBruine (www.facelab.org/debruine/Programs/rater).

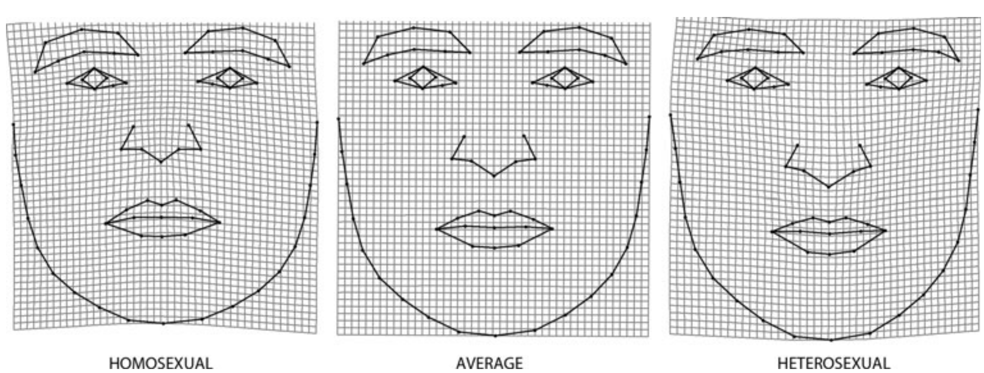

Fig. 1 Visualization of estimated landmark configuration on faces of homosexual (*left*) and heterosexual (*right*) men. The differences between a heterosexual and homosexual face is demonstrated by contractions and dilations of TPS deformation grids from average configuration (in the *middle*)

Data Analyses

To assess inter-rater agreement, we first computed Cronbach's alpha for ratings of sexual orientation (female raters: $\alpha = .94$; male raters: $\alpha = .89$) and ratings of masculinity–femininity (female raters: $\alpha = .95$; male raters: $\alpha = .95$).

Further, we computed the average ratings for each target individual as rated by both groups of raters (see Table 1). Since ratings of male and female raters correlated significantly in both masculinity–femininity and sexual orientation ratings ($r = .90, p < .001$; $r = .76, p < .001$, respectively), further analyses were conducted using mean scores from both male and female raters. It is worth to note that, in this study, similarly as in our previous study (Valentova et al., 2011), we did not use dichotomized judgments (strict judgments of either heterosexuality or homosexuality) but rather a continuous approach (i.e., rating individuals as closer to one or the other pole on the heterosexual–homosexual continuum). Thus, rather than studying the "accuracy" of attribution or percentages of "correctly" classified individuals, we aimed to test statistical associations between the observer's ratings of the target's sexual orientation (and masculinity–femininity) and target's self-ratings, both on 7-point scales. However, the target's responses about their sexual orientation grouped on both extremes of the scale. Therefore, for statistical testing of the link between self-reported sexual orientation and judged sexual orientation and judged masculinity–femininity, we used binary logistic regression where self-reported sexual orientation entered as a binary criterion and rated variables simultaneously as predictors.

We used two-tailed Pearson correlation to determine the relationship between judged sexual orientation and judged masculinity–femininity. Finally, in order to find whether the ratings of sexual orientation and masculinity–femininity were associated with the morphological characteristics of the face investigated in Study 1, we conducted a multivariate regression of shape coordinates on ratings of masculinity–femininity and sexual orientation.

Results

The binary logistic regression revealed a significant effect of judged masculinity–femininity ($B = 1.39$, $p = .012$) on self-reported sexual orientation, with homosexual men being rated as more masculine, but there was no significant effect of sexual orientation ratings ($B = .87$, $p = .13$). The correlation between judged sexual orientation and masculinity–femininity revealed a significant positive link, $r(66) = .46$, $p < .01$, indicating that faces rated as rather homosexual were also rated as more feminine. The shape regression showed a significant effect of judged masculinity–femininity on facial shape space ($p = .001$, for 1,000 permutation). The high perception of masculinity was characterized by wider faces with massive jaw and rounded chin (Fig. 2). Compared to feminine faces, the masculine facial configuration further showed thinner lips, thicker eyebrows, and smaller eyes. However, there was no significant effect of judged sexual orientation on facial morphospace ($p = .21$, for 1,000 permutations).

Discussion

Our results suggest significant differences in facial morphology between homosexual and heterosexual men. To our knowledge, this is the first study investigating facial traits in relation to sexual orientation using geometric morphometrics. These two groups of men showed differences in the shape of the nose, mouth, chin, and overall facial form. In general, observed differences in facial form showed a tendency to a dolichocephalic head form in the heterosexual sample compared to a rather brachycephalic head form in the homosexual sample. Theoretically, there are two extreme head shapes in the Caucasian population. The long, narrow, dolichocephalic head form is characterized by the specific topography of the face that includes a long narrow face with a longer and more protrusive nose. The brachycephalic head form is wide, short, and globular and associates with a wider, shorter, globular face with a vertically and protrusively shorter nose, which has a more rounded tip (Enlow & Hans, 1996). Nevertheless, it is worth pointing out that our data were limited to frontal facial pictures, and dolichocephalic and brachycephalic heads also have their profile dimension. Differences in facial form of homosexual and heterosexual men reported in this study further correspond, in part, to sex differences: (1) the long nose is considered a sexually dimor-

Table 1 Mean values and SDs for sexual orientation and masculinity–femininity judgments as a function of self-reported sexual orientation

	Judgments of sexual orientation		Judgments of masculinity–femininity (SD)	
	Heterosexual targets M (SD)	Homosexual targets M (SD)	Heterosexual targets M (SD)	Homosexual targets M (SD)
Male raters	3.48 (.44)	3.46 (.53)	3.52 (.49)	3.12 (.73)
Female raters	3.25 (.59)	3.37 (.81)	3.43 (.58)	3.10 (.71)
Male and female raters	3.37 (.48)	3.42 (.63)	3.47 (.52)	3.11 (.70)

Averaged ratings of sexual orientation and masculinity–femininity as judged by female and male raters and the combined sample

Lower values mean higher judged masculinity and higher judged heterosexuality, while higher values mean higher judged femininity and higher judged homosexuality

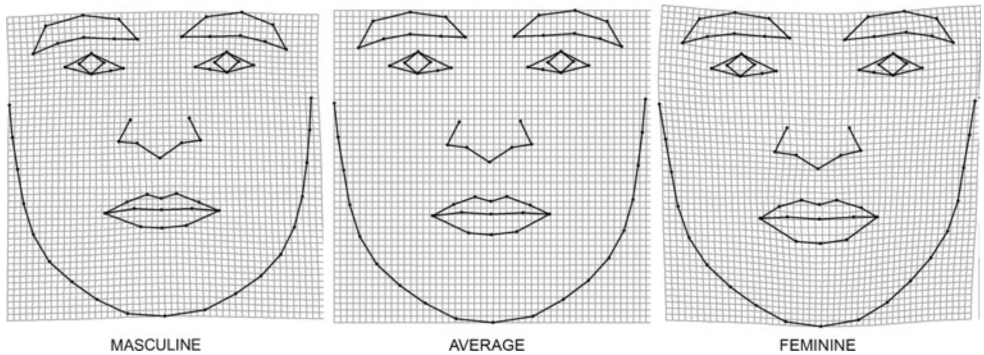

Fig. 2 Thin plate spline visualization of the shape regression upon judged masculinity–femininity. The *left grid* shows deformation from the average (*middle panel*) towards higher judged masculinity, while the *right grid* corresponds to shape changes associated with higher judged femininity

phic trait typical for men; (2) the wider basicranium is typical for men; hence, men, on average, have wider faces (Ferrario, Sforzi, Miani, & Tartaglia, 1993). On the other hand, some other sexually dimorphic facial traits were rather more masculine in our homosexual sample (e.g., wider jaw or thicker eyebrows), resulting in a mosaic of both feminine and masculine features. It is worth noting that the described differences of the two groups of individuals were appraised qualitatively and subsequent studies should focus on testing for the influence of these particular facial parts in sexual orientation attributions.

Thus, our results were partly in agreement with the previous body of research showing some female-typical traits in homosexual men compared to heterosexuals (for review, see LeVay, 2010). Some studies, for example, have shown that homosexual men tend to be shorter, lighter, and they have shorter long-bones than heterosexual men, which are traits which differ between males and females (Martin & Nguyen, 2004). One explanation of these differences between homosexual and heterosexual individuals consists in putative varying environmental factors, such as hormonal levels or prenatal maternal stress, acting on the development of physical and behavioral traits during early stages of individual development. This suggestion was supported by research reporting differences in brain anatomy, such as the hypothalamus (Byne et al., 2001; LeVay, 1991) and neurofunctional processes, such as spatial or verbal abilities (Gladue & Bailey, 1995), which are characteristics that develop very early during individual ontogeny. Thus, both sexual orientation and some of its somatic or personality correlates are thought to be caused by specific prenatal or early postnatal environmental factors. Similarly, variation in facial morphology reported in this study might refer to developmental differences between these two groups of individuals. Although our research was based on an adult population and previous studies reported substantial changes in facial morphology during individual ontogeny, especially during puberty (Farkas, 1981), a recent study aimed at morphological changes during ontogeny based on GMM methods reported that facial morphology is established within the first few years of life and correlates strongly with the adult face form (Bulygina, Mitteroecker, & Aiello, 2006). We may thus hypothesize that differences in facial shape between homosexual and heterosexual men, as well as other studied traits, arise early during development. Nevertheless, we are aware that more research is needed to decide whether the reported differences are also present in cohorts of different ages or in other populations.

We also found no significant difference in facial asymmetry between the two studied groups of men, which is in agreement with previous studies showing no relation of fluctuating asymmetry and sexual orientation (Rahman, 2005). These results contrast a theory stating that homosexual orientation is a result of developmental instability, which refers to an organism's inability to cope with developmental stresses (Lalumiere, Blanchard, & Zucker, 2000).

Nevertheless, the homosexual men in our sample also had some typical masculine facial traits, which might have caused the negative result in Study 2, where the raters did not attribute sexual orientation from facial pictures in concordance with self-reported sexual orientation of the rated targets. This might be explained by the fact that homosexual targets were rated as more masculine than heterosexual targets. Sexual orientation attributions discordant with the self-reported sexual orientation contrasts previous investigations on this topic that consistently show that lay people can infer sexual orientation from still photos even from a very short exposure to the picture (e.g., Rule & Ambady, 2008).

There were, however, several differences between the previous studies and the current one. First, unlike this study, all previous studies on sexual orientation attribution as based on facial pictures were conducted in the U.S. It is possible that Czech raters attribute sexual orientation to men according to a more stereotypical fashion, assuming more feminine appearance in male homosexuals. Nevertheless, in a previous study, it was found that Czech raters were able to judge male sexual orientation accurately according to video recordings (Valentova et al., 2011). Further and more importantly, in contrast to previous studies, we used highly standardized facial images where targets were instructed to adopt neutral facial expressions. In contrast, photos of targets in several previous studies (e.g., Rule et al., 2008; Rule & Ambady, 2008) were sampled from the Internet, which may constitute a major methodological dissimilarity.

Both methods have advantages and disadvantages and one of the main advantages of the previously used method is that even people unwilling to participate in such a study entered the research. This seems to be the main disadvantage of our method, where the representativeness of the sample was rather limited. At least, we tried to match the groups we were comparing on basic demographic traits, but, of course, our homosexual and heterosexual samples might have differed on other variables, which may have confounded the obtained results. Thus, further study using different sampling methods should be carried out in different cultural settings to clarify the reported differences. Furthermore, in several previous studies, facial pictures contained social cues, such as facial expressions, which might have contributed to the attribution of sexual orientation. It is thus not clear whether sexual orientation attributions are due to social or morphological factors, which seems to be an issue in more general research aimed at gender nonconforming individuals (e.g., Zucker, Wild, Bradley, & Lowry, 1993; McDermid, Zucker, Bradley, & Maing, 1998).

Finally, it is worth stressing that since we have found an effect of masculinity–femininity ratings but not of sexual orientation ratings, and at the same time these two rating types were positively correlated, it is questionable if gender nonconformity is the actual trait that cues sexual orientation. Thus, our argumentation is in line with a previous study by Rule et al. (2011), which showed that when selecting homosexual and heterosexual men who were rated as most masculine and most feminine, the accuracy of "gaydar" falls below the level of chance. This shows that sexual orientation judgment based on stereotyped gender specific traits leads to frequent misjudgment. We thus argue that, in further research focusing on average differences between homosexual and heterosexual men, masculinity–femininity should be controlled. In other words, we suggest that some specific differences between these groups might apply only to feminine homosexual men, but not masculine ones. Furthermore, it is possible that our sample coincidentally consisted of rather counter-stereotypic homosexual or heterosexual men and we thus could not report similar results of successful gaydar as found in previous studies.

To conclude, we found significant differences in facial morphology between men who identified as homosexual and heterosexual; however, these differences cannot be simply described as gender-related traits, but the distinction between homosexual and heterosexual men is rather characterized by a mosaic of masculine and feminine traits. Further, our raters were not able to ascribe sexual orientation accurately from facial images. From our observations, it would seem that sexual orientation is not as straightforward a trait as previous studies have suggested, at least not based on standardized facial pictures. Nevertheless, the morphological differences among homosexual and heterosexual men reported here have important implications for future research in sexual orientation and social perception.

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