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# Facialmetric similarities mediate mate choice: sexual imprinting on opposite-sex parents

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Former studies have suggested that imprinting-like processes influence the shaping of human mate preferences. In this study, we provide more direct evidence for assessing facial resemblance between subjects' partner and subjects' parents. Fourteen facial proportions were measured on 312 adults belonging to 52 families, and the correlations between family members were compared with those of pairs randomly selected from the population. Spouses proved to be assortatively mated in the majority of measured facial proportions. Significant correlations have been found between the young men and their partner's father (but not his mother), especially on facial proportions belonging to the central area of the face. Women also showed resemblance to their partner's mother (but not to their father) in the facial characteristics of their lower face. Replicating our previous studies, facial photographs of participants were also matched by independent judges who ascribed higher resemblance between partners, and subjects and their partners' opposite-sex parents, compared with controls. Our results support the sexual imprinting hypothesis which states that children shape a mental template of their opposite-sex parents and search for a partner who resembles that perceptual schema. The fact that only the facial metrics of opposite-sex parents showed resemblance to the partner's face tends to rule out the role of familiarity in shaping mating preferences. Our findings also reject several other rival hypotheses. The adaptive value of imprinting-related human mating is discussed, and a hypothesis is made of why different facial areas are involved in males' and females' search for resemblance.

**Keywords:** facial resemblance; sexual imprinting; homogamy

## 1. INTRODUCTION

Romantic partners tend to resemble one another in a large number of traits. Former studies based on demographic surveys have shown homogamy or assortative mating on large samples of human couples (Mascie-Taylor 1988, 1995). Positive correlations have been found between mates' socio-economic status, age, intellectual ability, education, personality attributes, physical attractiveness and anthropometric measures (Bereczkei & Csanaky 1996; Thiessen *et al.* 1997; Little *et al.* 2005). A study that used computer-graphic image manipulation has shown a significant relationship between similarity of faces to subjects and the subjects' ratings of attractiveness of the faces (Penton-Voak *et al.* 1999). In a set of studies on facial appearance, independent judges correctly matched long-term male and female partners at a significantly higher rate than expected by chance (Bereczkei *et al.* 2002, 2004). Several works suggest that genetic similarity within blood groups and major histocompatibility complex influences human attractiveness judgements and mate choice (Rushton 1989; Wedekind & Füri 1997; Roberts *et al.* 2005). A more recent study has found that the friends and spouses of monozygotic twins were more similar to each other in personality and social attitudes than those of dizygotic twins, and the results suggest that 10 to 30 per cent of the variance in partner choice is due to genetic factors Rushton & Bons (2005).

Partner choice on the basis of similarity may result from phenotype matching, a mechanism that enables individuals to detect some aspect of their own phenotype, match it to new unfamiliar individuals, and prefer those who possess the same or similar phenotype. Experimental evidence shows that both animals and humans are able to recognize genetic similarity on the basis of shared olfactory and visual cues (Weisfeld *et al.* 2003; Oda *et al.* 2006; Wedekind 2007).

Other studies on animal and human behaviour suggest that imprinting-like mechanisms are also responsible for choosing mates on the basis of similarity. Ethologists claim that an early exposure to parental characteristics has a large effect on later mate preferences (Lorenz 1965; Bolhuis & Bateson 1990). Cross-fostering experiments with various species of birds and mammals have revealed that during pair formation adults tend to prefer sexual partners that are similar to individuals that reared them (Immelmann *et al.* 1991; Ten Cate *et al.* 2006; Spence & Smith 2007). It was also shown that offspring learn primarily the characteristics of the opposite-sex parents' and siblings' phenotype (Vos 1995; Witte & Sawka 2003). Bateson (1983, 1988) argued that sexual imprinting serves an adaptive goal of optimal outbreeding. Since both inbreeding and outbreeding have obvious reproductive costs and benefits, an adaptive compromise has evolved between them with individuals choosing a mate with a moderate degree of relatedness.

Several studies suggest that psychological mechanisms related to sexual imprinting are likely to influence mate choice in humans. Using a computer-graphic method, it was found that women born to 'old' parents (over 30) were more attracted to older faces than those born to younger

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parents, and men's preferences for female faces were influenced by their mother's age and not their father's age in a long-term relationship (Perrett *et al.* 2002). A study that examined hair and eye colour of male and female participants, their partners and their parents found positive correlations between parental characteristics and actual partner characteristics (Little *et al.* 2002*b*). The partners' hair and eye colour resembled that of the opposite-sex parent but not that of the same-sex parent. Another study has shown that a woman prefers the odour of a man who has significantly more human leukocyte antigen (HLA) allele matches with her own alleles than a man with the least preferred odour. Furthermore, a woman's choices were based on matches to the alleles inherited from her father, but not on matches inherited from her mother (Jacob *et al.* 2002).

In a set of experiments, aimed at comparing more than 300 facial photographs of family members and controls, the judges correctly matched wives to their mother-in-law at a significantly higher rate than expected by chance (Bereczkei *et al.* 2002). A regression analysis has revealed that men who had received more emotional support from their mothers during childhood were more likely to choose mates similar to their mother than those whose mother provided a less positive emotional atmosphere (and rejected their daughters more). These findings suggest that experiences during a sensitive period in early childhood may shape one's later mate choice preferences through the observed features of the opposite-sex parent. Similar relationships have been found in families where daughters and their adoptive fathers lived together (Bereczkei *et al.* 2004). Judges found significant resemblance on facial traits between daughter's husband and her non-biological father, and this effect was influenced by the quality of the father–daughter relationship during childhood. This result in adoptive families suggests that a learning process (sexual imprinting) rather than a genetically prescribed detection and matching mechanism (phenotype matching) is responsible for similarity-based mate choice.

A recent study has provided facial metric data for measuring similarity between the face of fathers and that of males whom their daughters found attractive (Wiszewska *et al.* 2007). A significant correlation was shown between the proportions of fathers' faces and chosen faces, but only in cases when female participants reported a good relationship with their father during childhood. This correlation was expressed in the central section of the face, including facial proportions such as brow height/face height, nose height/width, mouth–brow/face height, etc. The authors argued that daughters might pay attention to this area of the face and use it as a template for later mate choice.

This study provided remarkable results, and gave additional, more direct evidence for supporting the hypothesis concerning imprinting-related mate preferences. At the same time, it has certain limitations and raises some further questions that need to be addressed. First, it focused only on the relationship of fathers and daughters and did not extend facialmetric comparisons into the whole family. Furthermore, the daughters' actual partners were not involved in their experiment; female participants rated photographs of 15 male faces and chose those who they found the most attractive. The measured similarities between fathers' faces and chosen faces may support the sexual imprinting hypothesis but do not guarantee that sexual imprinting-like processes do operate in real life. In this study, therefore, we extended the range of examined persons beyond the dyads of father and daughter to encompass all the six participants in a family who may be involved in an imprinting-based mate choice. Our sample consisted of young men and their long-term mate (or young women and their long-term mate), young men's father and mother, and young women's father and mother.

Another main reason for studying extended families was to rule out the effect of familiarity. People generally respond positively to familiar stimuli, and they may choose partners who possess characteristics similar to their parent simply because they initially get familiar with them during childhood. In this case, one's mental model of parents may develop from familiarity with them rather than from the social learning of them. However, if individuals shape mental representation of the opposite-sex parents but not the same-sex parents—as the sexual imprinting hypothesis predicts—the rival hypothesis based on familiarization effects could be rejected. We expect a woman's male partner showing a resemblance to her father but not to her mother, and a man's female partner resembling his mother but not his father.

Furthermore, what Wiszewska and her colleagues found are correlations between daughters' fathers' and their chosen mates' facial proportions. However, they did not examine the facial similarities in the general population. As a consequence, we do not know to what degree the facial similarities between daughter's father and daughters' mate differ from the average male–male facial comparisons, if they differ at all. From another perspective, it is not clear whether similarities in the measured facial metrics have anything to do with similarities assessed by daughters themselves (as in the self-resemblance experiments) or by outsiders (as in the photograph-matching experiments). In order to overcome these difficulties, we extended our experiments on facial resemblance in two ways. First, similarities between the subjects' mate and subjects' parents were compared with persons randomly paired from the sample. For this purpose, all the data of facial proportions were randomized that made comparisons possible among persons belonging to different families. In other words, the facial proportions of a randomly selected young man or woman and a randomly selected older man or woman were correlated, and, then, these random matches were compared with the matches between the facial metrics of young person's parents and their actual mate. Second, beyond measuring facial proportions, independent judges were asked to evaluate similarities among the subjects' mate and subjects' parents. As in our former experiments (Bereczkei *et al.* 2002, 2004), they looked at various sets of individual photographs and rated facial resemblance among them.

## 2. MATERIAL AND METHODS

### (a) *Subjects*

Of 67 families, 396 volunteers acted as subjects. The family consisted of six persons: young man, his long-term partner (or young woman and her long-term partner), his father and his mother, and her mother and father. The young persons

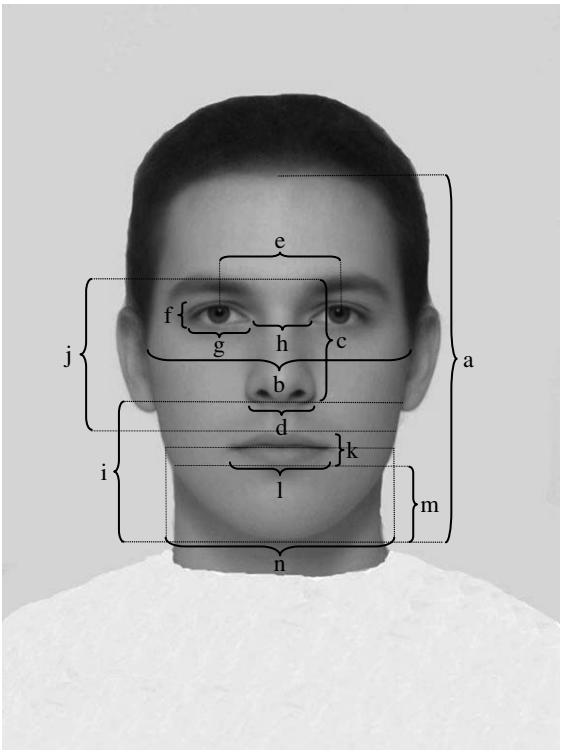


Figure 1. Facial metrics: a, face length; b, face width; c, nose length; d, nose width; e, distance between pupils; f, eye height; g, eye width; h, distance between inner eye corners; i, distance between nose and jaw; j, mouth–brow distance; k, lip fullness; l, lip width; m, jaw length and n, jaw width.

were randomly chosen from undergraduate and graduate students at our University. Their age ranged between 21 and 32 years (mean age of young men was 24.3 years, mean age of young women was 23.6 years), the average length of their relationship was 18.6 months. Digital photographs of the face of all the family members were taken. After the young persons had a picture of themselves taken in a room at the Institute of Psychology, their parents were asked if they could be photographed at their home. The participants were instructed to pose naturally and provide neutral expressions on their face. The background and camera distance were standardized. Fifteen families were excluded from the experiment because one or more parents were not willing to have their facial photograph taken, leaving 52 families, each with six members (312 persons). Additional portraits were taken of 318 men and women at an age comparable to that of the parents who were used as controls.

### (b) *Stimuli*

First, four sets of tableaux were made of the individual photographs in a manner as Bereczkei *et al.*'s (2002, 2004) former studies had developed. The tableaux showed:

— young man, his partner's father and three controls from the father's age group,
— young man, his partner's mother and three female controls from the mother's age group,
— young woman, her partner's father and three male controls from the father's age group, and
— young woman, her mother and three female controls in the mother's age group.

Thus, all the tableaux consisted of five persons. The young man's or woman's face (as the target face) was placed on the left-hand side of the tableaux, marked with a number. On the right-hand side, one of the partner's parents and the three controls were placed on the corners of a square, each marked with a letter. In the end, we had four sets of 52 tableaux. Then independent judges were asked to compare the target face (on the left-hand side) with each of the four photographs on the right-hand side and rate their similarity on a scale of 1–10. Fifty-seven undergraduate psychology students were used as independent judges to evaluate the similarity between young men and their partner's father and mother. Fifty two additional judges were asked to rate resemblance between women and their partner's parents. They saw the tableaux in random order. The judges were asked whether they were personally acquainted with any of the persons in the tableaux, and only those who were entirely unfamiliar with them were allowed to take part in the experiment.

### (c) *Facial measurements*

Facial measurements were made on all (312) individual faces, using Scion Image (v. 4.0.2. Beta). A fixed set of points was marked on each face using the mouse (figure 1). These points indicated the shape and position of internal features that were similar to those used in other studies (Jones 1995; Baudouin & Tiberghien 2004). The width, height, length and thickness of the features were all determined by computing the distance between two points. For the eye, as a double feature, the size reported was the mean of the two elements. Fourteen facial traits were measured from which 12 facial proportions were calculated based on comparing each facial trait with the height or width of the face or a particular facial trait (table 1). In other words, facial proportions were calculated by dividing the measured size of each facial dimension by the vertical or horizontal axis of the face.

### (d) *Data analysis*

First, correlations were computed between family members' facial metrics. Women and their partners' mother and father and men and their partners' mother and father were compared in 12 facial proportions. Then a randomization process was made in all variables for all the six family members. MICROSOFT Excel 97 VBA software can copy several hundred rows of data and reshuffle the list in a column of a particular variable (Walkenbach 2004). As a result, we could match faces of entirely unrelated and unfamiliar people who were at ages comparable with mates and their parents in our sample. Finally, using the MedCalc for Windows software (that can calculate sample size, Pearson correlation coefficient with $p$-value, and 95% CI for $r$), the degree of association between the two sets of variables could be analysed (Schoonjans 2008). The mate–parent correlations were compared with correlations between persons who had been formerly matched in a random way. As a result, we could assess whether similarity is significantly higher between the subjects' partners and the subjects' parents than between the individuals randomly selected from the population.

## 3. RESULTS

### (a) *Photograph matching*

As figure 2 shows, the judges ascribed resemblance between young partners which significantly exceeded the perceived similarity between opposite-sex young people who were randomly selected from the sample ($t=4.42$, $p<0.001$).

Table 1. Correlations between the young spouses' facial metrics compared to persons randomly selected from the sample. ($^{*}p<0.05$; $^{**}p<0.01$;$^{***}p<0.001$. Significant correlations are in italics.)

| | correlations | | |
|---|---|---|---|
| facial proportions | spouses | randomly selected | *z* |
| face length/face width | $0.395^{**}$ | −0.027 | *2.03*$^{*}$ |
| mouth–brow/face height | $0.339^{*}$ | −0.176 | *2.43*$^{*}$ |
| pupil distance/face width | 0.272 | −0.159 | *2.01*$^{*}$ |
| eye height/eye width | $0.399^{**}$ | 0.015 | *1.96*$^{*}$ |
| eye width/face width | 0.207 | −0.080 | 1.32 |
| eye corner distance/face width | 0.277 | −0.314 | *2.58*$^{**}$ |
| nose length/face height | $0.728^{***}$ | −0.130 | *4.83*$^{***}$ |
| nose width/face width | 0.104 | −0.030 | 1.07 |
| lip fullness/lip width | 0.182 | −0.108 | 1.33 |
| mouth width/face width | $0.578^{**}$ | 0.068 | *2.70*$^{**}$ |
| jaw length/face length | $0.425^{**}$ | −0.154 | *2.79*$^{**}$ |
| jaw width/face width | $0.531^{**}$ | −0.025 | *2.82*$^{**}$ |

Significant resemblance was attributed to the young men and their female partner's father in comparison with the controls (figure 2). A paired *t*-test showed that the independent judges rated the face of the partner's father as more similar to the young men than that of controls on average ($t=2.81$, $p<0.05$). No resemblance was ascribed by them between the young men and their partner's mother ($t=1.531$, $p>0.05$).

A high degree of similarity was also ascribed to the young women and their partner's mother (figure 2). The judges found the partner's mother on average more similar to young women then controls ($t=4.202$, $p<0.05$). At the same time, compared with the young women, the partner's fathers were not ranked higher on the similarity rank than controls ($t=-1.18$, $p>0.05$).

In summary, it appears that the young participants tend to choose partners who resemble their opposite-sex but not the same-sex parents.

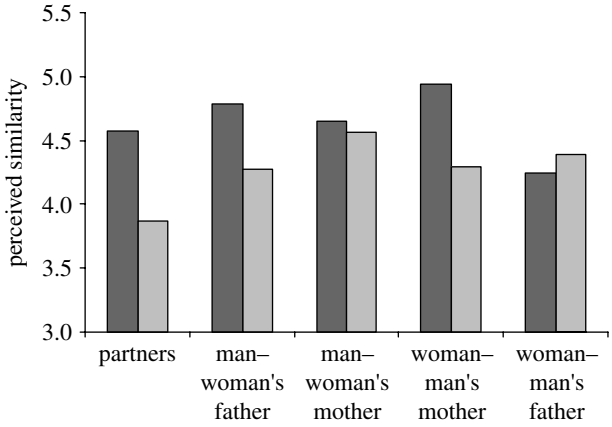


Figure 2. Resemblance assessed by independent judges between the partners, and the subjects' parents and the subjects' mates (dark grey bars), compared with controls (light grey bars).

### (b) *Facial measurements*

Significant correlations have been found between the partners of young couples for 9 of 12 facial measurements, suggesting an assortative mating for facial resemblance. As table 1 shows, spouses resemble more in 9 of 12 facial proportions than opposite-sex dyads randomly selected from the sample.

Facial proportions of the young men were correlated with those of their partner's father and these data were compared with correlations between individuals with comparable ages who were randomly selected from the sample. Facial measurements yielded similarities between the young men and their partner's father (opposite-sex parent) on seven facial proportions: mouth–brow distance/face height, distance between pupils/face width, eye width/face width, distance between the inner eye corners/face width, nose length/face height, nose width/face width, and jaw length/face length (table 2). These characteristics—with the exception of jaw length—belong to the central part of the face. The other facial areas have not shown significant correlations. With one exception, no correlations were found in these facial proportions between the young men and their partner's mother, suggesting that a partner's resemblance to father, but not to mother, plays a crucial role in their daughter's mate choice.

As a next step, we made an attempt to reduce the correlations to one component and show an overall metric of similarity. For comparing the sizes of all correlations for the same-sex versus opposite-sex parents, a paired-samples test was used. We found that correlations 'as a set' for the young men's opposite-sex parents were significantly higher than those for same-sex parents (0.304 versus 0,184, $t=2.34$, $p<0.05$). Furthermore, using a one-sample test, we wanted to find out whether these correlations as a set differ from zero. The results have shown that the correlations for both opposite-sex parents and same-sex parents significantly differed from zero (opposite-sex parents: s.d. $=\pm0.216$, $t=4.87$, $p<0.001$, same-sex parents: s.d. $=\pm0.111$, $t=5.878$, $p<0.001$).

Finally, we have made an analysis on the possible intercorrelations between the different facial measurements. One of the referees suggested we investigated whether a single overall facial metric such as face length/face width is responsible for the multiple similarities. Our results tend to reject this assumption: face length/face width did not correlate with those facial proportions that appeared significant in the father–mate comparison (eye width/face width: $r=-0.132$, eye corner distance/face width: $r=-0.179$, nose length/face height: $r=0.040$). The only significant correlation proved to be very weak (pupil distance/face width: $r=-0.242$, $p<0.05$).

Table 2. Correlations between the female subjects' mates and the subjects' parents compared with persons randomly selected from the sample. ($^{*}p<0.05$; $^{**}p<0.01$; $^{***}p<0.001$. Significant correlations are in italics.)

| | correlations | | | correlations | | |
|---|---|---|---|---|---|---|
| facial proportions | father–mate | randomly selected | *z* | mother–mate | randomly selected | *z* |
| face length/face width | 0.078 | −0.082 | 0.54 | 0.141 | −0.052 | 0.85 |
| mouth–brow/face height | 0.264 | −0.159 | *1.98*$^{*}$ | 0.329$^{*}$ | −0.016 | 1.73 |
| pupil distance/face width | 0.567$^{**}$ | −0.089 | *3.36*$^{***}$ | 0.277 | −0.034 | 1.45 |
| eye height/eye width | −0.016 | −0.109 | 0.69 | 0.114 | −0.142 | 1.02 |
| eye width/face width | 0.547$^{**}$ | −0.240 | *3.93*$^{***}$ | −0.095 | −0.042 | −0.244 |
| eye corner distance/face width | 0.446$^{**}$ | −0.176 | *3.18*$^{**}$ | 0.266 | 0.110 | 1.25 |
| nose length/face height | 0.720$^{***}$ | 0.076 | *3.81*$^{***}$ | 0.361$^{*}$ | 0.082 | 1.54 |
| nose width/face width | 0.276 | −0.254 | *2.01*$^{*}$ | −0.123 | −0.016 | 0.49 |
| lip fullness/lip width | 0.199 | 0.219 | −0.09 | −0.233 | −0.300 | 0.035 |
| mouth width/face width | 0.175 | −0.243 | *1.94*$^{*}$ | −0.010 | −0.072 | 0.28 |
| jaw length/face length | 0.198 | −0.276 | *1.93*$^{*}$ | 0.163 | −0.395 | *2.66*$^{*}$ |
| jaw width/face width | −0.168 | 0.119 | 1.32 | 0.095 | 0.160 | 0.30 |

Table 3. Correlations between the male subjects' mates and the subjects' parents compared with persons randomly selected from the sample. ($^{*}p<0.05$; $^{**}p<0.01$; $^{***}p<0.001$. Significant correlations are in italics.)

| | correlations | | | correlations | | |
|---|---|---|---|---|---|---|
| facial proportions | mother–mate | randomly selected | *z* | father–mate | randomly selected | *z* |
| face length/face width | 0.786$^{***}$ | −0.093 | *5.28*$^{**}$ | 0.033 | −0.031 | 0.29 |
| mouth–brow/face height | 0.116 | −0.055 | 0.17 | 0.282 | 0.440 | 0.83 |
| pupil distance/face width | −0.257 | −0.223 | −0.16 | −0.079 | −0.317 | 1.14 |
| eye height/eye width | 0.145 | −0.317 | *2.17*$^{*}$ | 0.361 | −0.149 | *2.43*$^{*}$ |
| eye width/face width | −0.029 | −0.093 | 0.56 | 0.379 | −0.151 | 1.95 |
| eye corner distance/face width | 0.005 | −0.314 | 1.51 | 0.020 | −0.280 | 1.41 |
| nose length/face height | 0.075 | 0.119 | −0.21 | 0.231 | 0.280 | −0.24 |
| nose width/face width | −0.275 | −0.042 | 1.10 | 0.095 | 0.257 | 0.96 |
| lip fullness/lip width | 0.676$^{**}$ | 0.106 | *3.27*$^{***}$ | 0.327 | 0.005 | 1.53 |
| mouth width/face width | 0.275$^{*}$ | −0.243 | *2.04*$^{*}$ | 0.010 | −0.072 | 0.28 |
| jaw length/face length | 0.177 | −0.264 | *2.05*$^{*}$ | 0.250 | −0.166 | 1.58 |
| jaw width/face width | 0.928$^{***}$ | −0.102 | *8.01*$^{***}$ | 0.136 | 0.078 | 0.26 |

Facial factors of young women were correlated with their partners' mothers, and these correlations were compared with correlations between randomly selected individuals of comparable age. This test has yielded significant correlations on five facial proportions: face length/face width, lip fullness/lip width, mouth width/face width, jaw length/face length and jaw width/face width (table 3). Four out of the five characteristics belong to the lower part of the face, whereas face length/face width represents a basic proportion of facial shape. The facial characteristics of the same-sex parent did not appear to have a profound influence on men's mate choice; only one, weakly significant correlation (eye height/eye width) has been found between young women and their partner's father.

Paired-samples and one-sample tests were also achieved for the correlations 'as a set' between young women's same-sex and opposite-sex parents. Contrary to our expectations, correlations for the opposite-sex parents were not higher than those for the same-sex parents (0.238 versus 1.950, $t=0.612$, $p>0.05$). However, the opposite-sex parent correlations significantly differed from zero (s.d. $=0.154$, $t=3.817$, $p<0.01$), whereas the same-sex parent correlations did not (s.d. $=0.387$, $t=1.953$, $p>0.05$). Finally, an intercorrelation analysis has revealed that the measured similarities were not due to one underlying factor: the face length/face width facial proportion did not correlate with other measurements that proved to be significant in mother–mate comparison (lip fullness/lip width: $r=-0.167$, mouth width/face width: $r=-0.081$, jaw width/face width: $r=0.157$).

## 4. DISCUSSION

Our results show that:

(i) young partners have been assortatively mated; they were perceived more similar by independent judges than control persons, and significant correlations have been found between them in 9 of 12 facial measurements.

The fact that spouses are similar to one another raises a question about the underlying mechanism: what matching process is responsible for the measured similarities between partners? In accordance with our previous hypothesis, sexual imprinting seems to play a crucial role

in assortative mate choice. This assumption is supported by the results that:

(ii) independent judges rated the face of the partner's opposite-sex parent as more similar to young persons than that of control persons or that of the partner's same-sex parent,
(iii) compared with randomly selected pairs, significant correlations have been found between young men's and their partner's father's (but not their partner's mother's) facial proportions characteristic of primarily the central area of the male face,
(iv) women showed significant concordance with their partner's mother (but not with their partner's father) in facial proportions, especially with respect to the lower area of the female face, and
(v) the correlations as a set for the young men's opposite-sex parent were significantly higher than those for their same-sex parents, whereas no significant difference was found in this respect on the female side.

These findings appear to support the sexual imprinting hypothesis and provide additional evidence for the results that have been found in former studies (Bereczkei *et al.* 2002, 2004; Little *et al.* 2002*b*). Young adults show facial similarity to their partner's opposite parent that may come from a socialization process: children learn the particular features of the opposite-sex phenotype during childhood, and later they prefer long-term mates who show a certain degree of similarity to this parent. They build up an image of their parents' appearance (and probably their behaviour) and search for a partner who resembles that mental representation.

Our results do not support the idea of a familiarity effect in shaping mating preferences. If familiarity alone might account for choosing a partner, resemblance to opposite-sex and same-sex parents should equally influence mate preferences. In this case, individuals would simply adopt a perceptual schema of any of the family members who they had contact with as children, and the partner's phenotype would resemble either their mother or father. However, this is not the case, since only one's opposite-sex parental prototype influences one's mate choice. This is in line with the results of observations and experiments among animals and humans (Vos 1995; Little *et al.* 2002*b*; Bereczkei *et al.* 2004). A study using molecular techniques has shown significantly higher HLA allele matches between the donors of a woman's most preferred donor and a woman's father than between the preferred donors and her mother (Jacob *et al.* 2002). We can speculate that during evolution, humans have been selected to be sensitive to specific cues coming from their opposite-sex parents in childhood. Obviously, if features of parental phenotype influence mate choice criteria, in the case of a heterosexual partner relationship individuals may tend to recall perceptual schemas from the opposite-sex parent rather than from same-sex parent.

Sexual imprinting processes in mate choice may be adaptive in several ways. Individuals who had a good relationship with their opposite-sex parent during childhood and later choose partners with traits similar to this parent may be successful in their pair bonding because their partners who bear a resemblance to their caring parent may be more likely to be a good parent herself/himself (Wiszewska *et al.* 2007). Conversely, children who have grown up in a stressful family atmosphere may develop an aversion to parental features. In support of these expectations, our former studies have revealed that daughters who received more emotional support from their (adoptive) father were more likely to choose mates similar to the father than those whose father provided a less positive emotional atmosphere (Bereczkei *et al.* 2004). Similarly, a negative correlation has been found between maternal rejection towards son and mother–partner resemblance (Bereczkei *et al.* 2002).

Imprinting-like processes may have an effect on mate choice via assortative mating or homogamy. Given the 50 per cent overlap between the parents' and the offspring's genetic material, a similarity between one's mate and his/her opposite-sex parent can be expressed in the similarity between mates. Homogamy may confer individuals with additional adaptive advantages (Bateson 1983; Read & Harvey 1988). First, it may increase the degree to which parents share genes with offspring, and thus enhances the genetic representation in future generations. Second, assortative mating might also prevent genetic complexes coadapted to the local environment from being disrupted, thereby enhancing reproductive success. Obviously, an extreme degree of homogamy can impose serious reproductive costs; therefore an adaptive compromise (optimal outbreeding) has evolved between the opposing selectional pressures of inbreeding and outbreeding, with individuals choosing a mate with a moderate degree of genetic similarity. Finally, people may choose long-term partners in the hope of behavioural compatibility. Human couples who are similar in physical and psychological characteristics are more likely to remain together than dissimilar partners, and this may lead to an increase in fertility (Weisfeld *et al.* 1991; Bereczkei & Csanaky 1996).

Several authors have argued that sexual imprinting is a result of socialization processes without any adaptive function. A side effect of developmental plasticity in the face processing regions of the brain may bias mate choice towards specific familial traits. As children are exposed to the faces of their parents more than those of other adults, these characteristics may be particularly important in influencing mate preferences (Perrett *et al.* 2002). However, as we have seen, familiarity, in itself, is not likely to lead individuals to search for a partner who fits their parents' mental template. The fact that partners resemble only the opposite-sex parents, but not the same-sex parents, makes it unlikely that a passive exposure to adults during childhood would be responsible for similarity-induced mate choice.

We have findings that we cannot explain at the moment. We have found similarities between men's mother and men's partners on four characteristics of the lower part of the face (lip fullness/lip width, mouth width/face width, jaw length/face length and jaw width/face width), and one feature peculiar to face shape (face length/face width). The concordance between women's fathers and women's partners was expressed on six characteristics belonging to the central area of the face (mouth–brow distance/face height, distance between pupils/face width, eye width/face width, distance between the inner eye corners/face width), nose length/face height,

nose width/face width and one feature on the lower face (jaw length/face length). Similar results have been found by Wiszewska *et al.* (2007) in the case of women's mate choice. They speculated that women might pay most attention to the central part of their father's face as a template because it is least prone to change over time or because it is the most distinctive aspect of the father's face.

In the light of our findings, it is also possible that people internalize the opposite-sex parent's phenotype in a sexually dimorphic manner. Males and females choose different facial areas of parents to be modelled, in accordance with their general sexual preferences for facial traits. More specifically, as our results indicate, men are expected to focus on the facial traits of their mother that are primarily related to the females' high mate value: lip fullness, jaw size and facial shape (Jones 1995; Cunningham *et al.* 2002; Thornhill & Gangestad 2006). We have also found a significant relationship between women's father and the women's partner in the lower area of the face characterized by facial proportions, such as distance between eyes, nose size and jaw size, which are associated with salient male features on the masculine–feminine scale (Little *et al.* 2002*a*; Penton-Voak *et al.* 2004; Waynforth *et al.* 2005). We speculate that people who mentally represent certain features of their opposite-sex parent's face tend to seek a partner whose face may express both similarity and attractiveness. However, our recent study is not suitable for testing this particular assumption: measures may be intercorrelated, and the modest sample size does not allow us to precisely ascertain which facial proportions are linked to male and female mate choices. More research is needed to answer this question.

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