

Parental resemblance in 1-year-olds and the Gaussian curve

Paola Bressan* and Massimo Grassi

Do infants look more like their fathers or their mothers? The available data are contradictory, but were collected through different procedures: either by asking judges to identify the parent in a triplet of adults (straight guess), or by asking them to rate resemblance on a scale and then recoding highest ratings to parents as correct guesses (guess from rating). Here, we used both procedures and compared their results. Eighty judges were asked, first, to estimate the facial resemblance of 40 one-year-olds to each of three adults; and then, to guess which adult in each triplet was the parent. Accuracy was better than chance with both methods, but performance in the guessing task was significantly higher. Judgments of parental resemblance were distributed normally, with a few infants preferentially resembling one parent (father or mother with equal probability), and most resembling father and mother to approximately the same degree.

1 Introduction

Genotypic traits are partly expressed phenotypically, and, for this reason, children are expected to look like their genetic parents more than like unrelated adults. This expectation, however, is not unequivocally supported by the data. In a study by Christenfeld and Hill (1995), neutral judges were shown black-and-white photographs of faces and asked to rate the resemblance between one-year-olds and each individual in a triplet of men (or women) that included the biological father (or mother) of the infant. The same procedure was repeated with pictures of the same children at ages 10 and 20. Results were surprising. In general, children were not judged more similar to their parents than to unrelated adults, except that one-year-olds were judged more similar to their fathers than to unrelated men.

*Corresponding author. Dipartimento di Psicologia Generale, Via Venezia 8, 35131, Padova, Italy. email: paola.bressan@unipd.it.

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These results could not be replicated by Brédart and French (1999), who presented neutral judges with sets of four black-and-white pictures representing a child (one, three, or five years old) and three men (or women), one of whom was the child's genetic father (or mother). Judges had to guess which of the three adults was the parent. Brédart and French found that (i) at all ages, children were matched to their parents at a rate higher than chance; (ii) at no age were they matched to one parent more reliably than to the other; and (iii) the older the child, the higher the probability that judges made the correct choice. None of these findings was in agreement with Christenfeld and Hill's.

In a third study, McLain, Setters, Multon, and Pratt (2000) tested whether judges could identify the parents of newborns (1-3 days old). First, parents were interviewed and asked whether the newborn was more similar to Mother or Father. Overall, mothers were more likely to say that the newborn resembled Father, whereas fathers were not. Then, neutral judges were shown pictures of the newborns, accompanied by (a) pictures of both Mother and Father, together with two unrelated men and two unrelated women, or (b) the picture of Father (or Mother) only, together with two unrelated men (or women), and were asked to guess the biological parent. The results of this part of the study contradicted what parents had reported in the interview: mothers were easier to pick out, which indicated that they resembled their babies more than fathers did. Thus, the results of McLain et al. (2000) are opposite to Christenfeld and Hill's (1995), but also differ from those of Brédart and French (1999).

In sum, three studies have assessed whether young children resemble their parents and if so, whether they resemble one parent more. The only consistent finding is that judges perform poorly, selecting the correct parent at a rate only 1.1 to 1.3 times higher than chance. Contradictory results are that children resemble mothers more than fathers (McLain et al., 2000), fathers more than mothers (Christenfeld & Hill, 1995), and both equally (Brédart & French, 1999). Christenfeld and Hill (1995) argue that father-child resemblance benefits the baby by increasing confidence of paternity and encouraging paternal investment, whereas Brédart and French (1999) and McLain et al. (2000) propose that it is to the child's advantage to conceal paternity to deceive cuckolded social fathers.

Brédart and French (1999) and McLain et al. (2000) used similar methods, but that employed by Christenfeld and Hill (1995) was different. In the latter case, judges were asked to rate resemblance on a scale from 1 to 10, and the data were then recoded by calling cases where the highest rating was given to the parent correct, and all other cases incorrect (Guess From Rating, GFR). In the two later studies, judges were asked to guess the correct parent directly (Straight Guess, SG). It is possible, then, that the two methods induced different approaches to the task. When asked to rate the degree of resemblance between two faces, judges probably try to

estimate overall similarity, but when asked to guess whether two individuals are related, they could either assess overall similarity or attend to common traits, such as eyes of the same shape. Two individuals sharing a peculiar or unusual single feature, such as dimples or very full lips, might receive a low global resemblance rating and yet be considered very likely to be relatives. Hence, the discrepancies between the findings of Christenfeld and Hill (1995) and those of subsequent studies could be attributable to different methods.

Alternatively, the divergent results could be due to sampling, and hinge on the shape of the distribution of parental resemblance, which is unknown. For example, the distribution could be normal, with most infants resembling both parents equally, or it could be bimodal with about half of the infants resembling the mother more than the father, and about half the reverse. In either case, the average infant would turn out to look as much as like mother as father.

The aims of the current study were, first, to test whether the difference between the results of Christenfeld and Hill (1995), on the one hand, and Brédart and French (1999) and McLain et al. (2000), on the other, was due to different methods, and second, to test whether individual infants tend to look like both parents to about the same extent, or preferentially like one of them.

2 Methods

2.1 Materials

We used a total of 120 color photographs, representing 40 infants (22 girls and 18 boys) and their 80 parents. All individuals had the same ethnicity (Italian), but they varied in eye and hair color, and in facial features. Infants had an average and median age of 12 months (minimum 2, maximum 18). Some photographs came from family albums; others were taken especially for the experiment, using different backgrounds for each individual.

Four photo albums were prepared. Each album had 20 pages, and each page featured 4 photos: one infant, the biological mother (or father) and two unrelated adult females (or adult males), who were parents of infants not appearing in that album. Half of the infants were accompanied by females, the other half by males. The album page was divided into 4 sections, with the photo of the infant always placed in the top left quadrant. Each album included photos of 11 girls and 9 boys.

2.2 Procedure

Judges were divided into four groups of 20 (10 females, 10 males); each group evaluated a single photo album. The order of pages in the album was separately randomized for each judge, and the two unrelated adults

accompanying the photo of each infant were changed systematically, so that each judge compared each infant to different unrelated adults.

The experiment was conducted in two steps. Judges were first asked to rate the facial resemblance between the infant and each of the three adults, page by page, on a scale from 0 (no resemblance) to 10 (very high resemblance), with no other information provided. After these ratings were completed, judges were told that one of the three adults was the infant's biological parent and were asked to go through the album again, and guess, for each set of photos, which adult it was.

2.3 Results

2.3.1 Resemblance ratings

A preliminary analysis of variance (ANOVA) showed no significant effect of album ($F < 1$), so data from the four groups of judges were pooled. A three-way ANOVA was performed, with a between-subjects variable of sex of judge and within-subjects variables of sex of adult (female vs male) and relationship to infant (parent vs nonparent). Male judges gave slightly higher ratings than females [$M = 4.31 \pm 0.14$ (*SEM*) vs 3.8 ± 0.11 , $F_{(1,78)} = 3.69$, $p = .058$], but this variable did not interact significantly with any of the others. Overall, infants were judged more similar to their parents than to nonparents [$F_{(1,78)} = 159.27$, $p < .0001$] and more similar to women than to men [$F_{(1,78)} = 7.66$, $p = .007$]. The two-way interaction was not significant ($F < 1$), indicating that infants tended to resemble women more than men regardless of parental relationship (see Fig. 1).

2.3.2 How much do one-year-olds resemble their parents, relative to nonparents?

We calculated how frequently judges used each value on the 0-10 rating scale when evaluating resemblance of infants to parents versus nonparents. The mode of both distributions was zero. A zero rating occurred in about 18% of cases when assessing resemblance to parents, and 30% of cases when assessing resemblance to nonparents.

Ratings were converted into Parental Badge Indices (PBI) by subtracting, for each judge and each infant, the rating given to each of the unrelated men (or women) presented with the infant from the rating given to the father (or mother). Therefore, PBI is a measure of infant-parent resemblance relative to infant-nonparent resemblance. It can in principle range from -10 (perfect resemblance to nonparent, no resemblance to parent) to 10 (perfect resemblance to parent, no resemblance to nonparent). PBIs of "zero" indicate perfect anonymity: equal resemblance to parent and nonparent.

The PBI distribution is plotted in Fig. 2, separately for mothers and fathers. In both cases, the median was 2 and the mode was zero. Mean

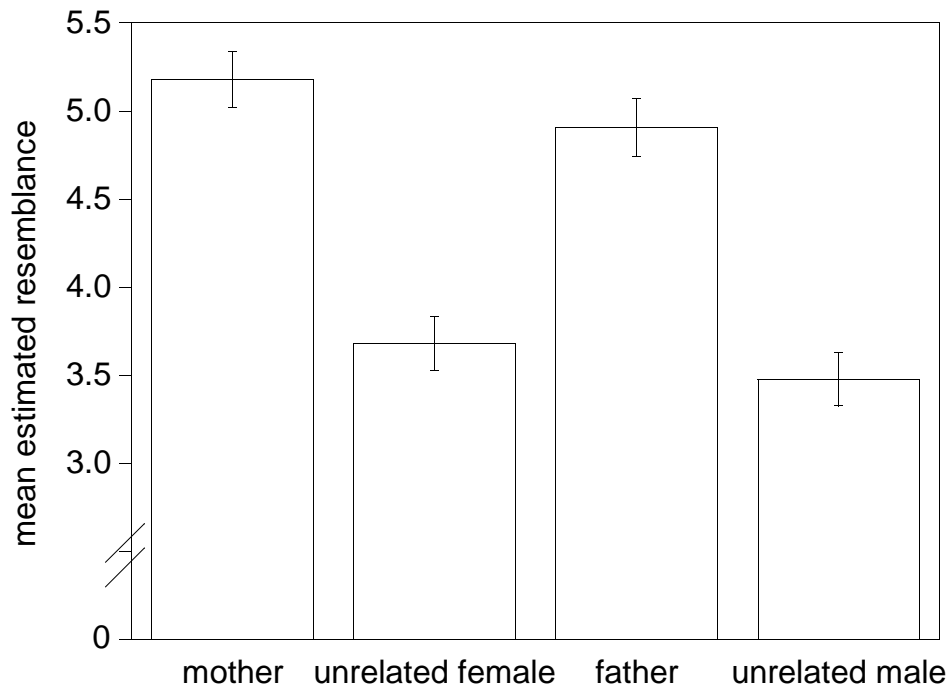


Figure 1: Mean (and SEM) estimated resemblance on a scale from 0 (no resemblance) to 10 (very high resemblance) as a function of genetic relatedness between adult and infant.

PBIs for mothers (1.53 ± 0.14) and fathers (1.42 ± 0.16) were not significantly different from each other [$t_{(79)} < 1$].

2.3.3 Do one-year-olds resemble their father more than their mothers?

Ratings were converted into Father Badge Indices (FBI) by subtracting, for each judge and each infant, the rating given to the mother of a given infant from the rating given to the father of the same infant. Therefore, FBI is a measure of infant-father resemblance relative to infant-mother resemblance, which, as with PBI can in principle range from -10 to +10 . FBIs of “zero” indicate an absence of bias in resemblance to Father or Mother.

The mean of the FBI distribution was -0.27, whereas both median and mode were zero. The distribution was not different from a normal distribution (Kolmogorov-Smirnov test: K-S $Z = .065$, $df = 100$, $p = .20$). Forty percent of the infants fell within the ± 2 range, as can be seen in Figure 3.

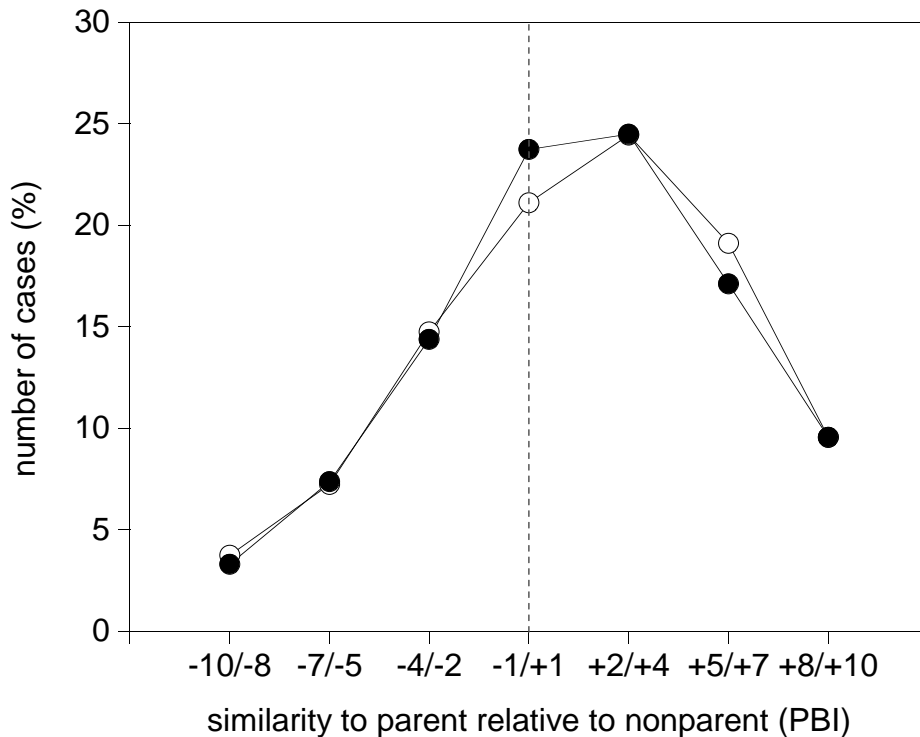


Figure 2: Frequency distribution of mean Parental Badge Indices (estimated resemblance of the infant to the parent minus estimated resemblance of the infant to the unrelated adult), plotted separately for mothers (open symbols) and fathers (solid symbols). The vertical dashed line represents perfect anonymity.

2.3.4 Guesses From Ratings

Following Christenfeld and Hill (1995), ratings collected in the first part of the experiment were recoded as correct and incorrect guesses (GFR). The maximum value within each triplet of ratings was labeled as the correct choice if it was assigned to the biological parent, and incorrect otherwise. If both the parent and one (or both) of the unrelated adults were given the same maximum rating (Multiple Maxima, MM), the choice was coded as incorrect. We counted 146 MMs out of 1600 judgments (80 judges \times 20 album pages), 9.12% of the cases. Fifty-nine judges gave at least one MM; the remaining 21 always assigned a single maximum for each album page.

Mean numbers of correct guesses by male and female judges were not significantly different ($F < 1$), indicating that men and women were equally adept at identifying parents. Also, the proportions correct for mothers (.48)

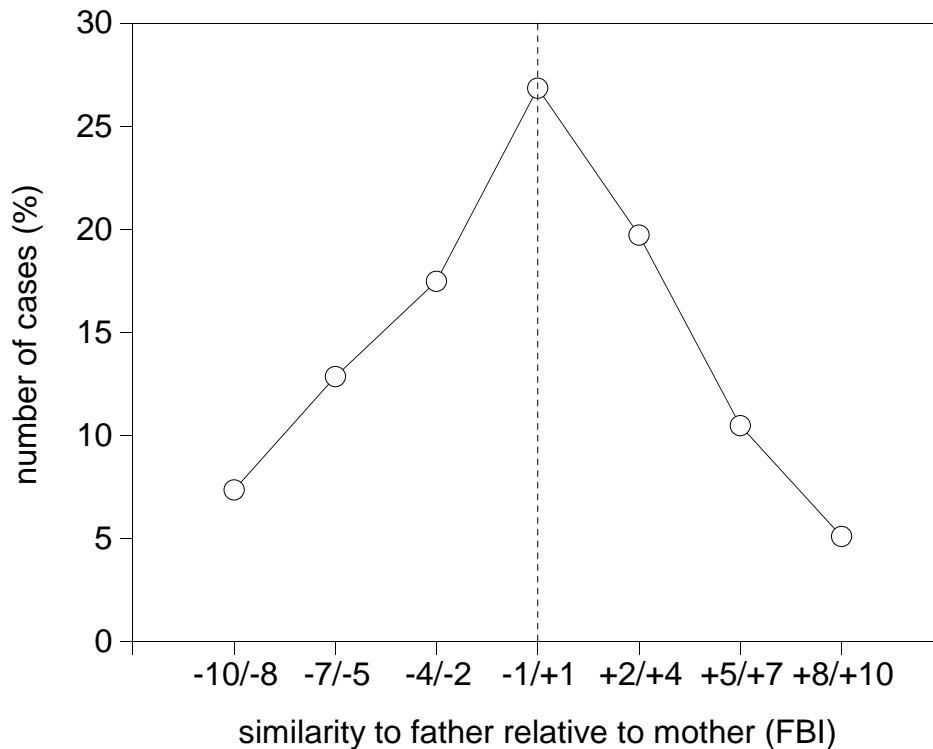


Figure 3: The frequency distribution of mean Father Badge Indices (estimated resemblance of the infant to the father minus estimated resemblance of the infant to the mother) is a Gaussian curve. The vertical dashed line represents an absence of bias in resemblance to Father or Mother.

and fathers (.44) were not significantly different [$F_{(1,78)} = 2.68, p = .105$]. The overall probability of guessing the biological parent (.45) was 1.37 times higher than the probability expected by chance (.33); one-sample $t_{(79)} = 8.82, p < .0001$.

2.3.5 Straight Guesses

Results collected in the second part of the experiment were transformed into mean proportions of correct guesses by averaging across data for individual infants, separately for sex of adult. Accuracy was not significantly different for men versus women ($F < 1$), nor was the probability of correctly guessing Mothers (.50) significantly different from that for Fathers (.48), ($F < 1$). The overall probability of guessing the biological parent was .49, which is 1.47 times higher than chance; one-sample $t_{(79)} = 12.37, p < .0001$.

2.3.6 Comparison of the two procedures

GFR and SG data were compared in order to understand whether there was any difference in the results collected with the two procedures. Performances in the two conditions were highly correlated, Pearson $r = .625$, $N = 1600$, $p < .0001$, but Straight-Guess accuracy was significantly higher than Guess-From-Rating accuracy [$F_{(1,79)} = 7.87$, $p = .006$].

In order to understand why GFR and SG differed, Multiple-Maxima responses given in the first part of the experiment were compared with the responses given to the same pictures in the second part. We computed an improvement index for each individual response by subtracting the GFR probability of correct guess from the SG probability of correct guess. This index ranged from -1 (worsening of the performance), to +1 (improvement of the performance). Zero indicated no change. Forty-five percent of MM responses (66 out of 146) became correct guesses when switching from GFR to SG [$t_{(145)} = 10.93$, $p < .0001$]. For the remaining responses, the improvement index was not different from zero [$M = -.01$, $t_{(1453)} < 1$], indicating that, when asked to select a single adult among two (or more) who had been rated as equally similar to the infant, judges did tend to make the correct choice.

2.4 Discussion

We found that one-year-olds resemble their parents more than strangers, and their fathers as much as their mothers. Both results are in agreement with the data for one-year-olds reported by Brédart and French (1999), and in disagreement with those reported by Christenfeld and Hill (1995).

Our double-method experiment showed that the contradiction between these data was not due to the different methods. However, it also showed that accuracy does depend on the method, and that the procedure of asking judges to guess the most likely parent is preferable to that of asking them to simply rate resemblances. It appears that, under forced choice, people are able to use relatedness cues not obvious or relevant enough to affect similarity ratings.

We found that infants are more similar to women than to men. This agrees with data collected on 8-year-olds by Bressan and Dal Martello (2002), and with the observation that the facial traits of women are more infantile than those of men. We suggest that the neoteny of female traits might have actually contributed to the better performance for father/infant than for mother/infant pairs in Christenfeld and Hill (1995) experiment. When people are asked to rate similarity rather than pick out the parent, paternal (as opposed to maternal) resemblance might emerge simply because infants do not look much like other men, whereas they look like many other women besides their mothers. If, in Christenfeld and Hill's photograph sample, the

gap between infants' resemblance to unrelated women versus unrelated men was larger than the gap between infants' resemblance to mothers versus fathers, the net result would have been superior accuracy for man/infant pairs. Higher accuracy for man/child pairs has in fact been reported by Bressan and Dal Martello (2002) in two resemblance-rating experiments done with the same photograph sets of parents and nonparents, whereas in a third experiment, where the parents were the same but the nonparents were different, accuracy was higher for woman/child pairs. The method based on similarity ratings, in conclusion, appears especially vulnerable to chance variation in facial neoteny of women unrelated to the infant, and can therefore lead to spurious accuracy differences between father/child and mother/child pairs.

Parental resemblance in 1-year-olds has a normal distribution, with most infants resembling Mother and Father about equally. Although this may seem at odds with daily experience, most spontaneous remarks of parental resemblance may be stimulated by children whose similarity to either Mother or Father is higher than average - the few children that fall in the tails of the distribution are noticed and remembered far more easily than the many in the middle.

Finally, we confirmed that parental resemblance in one-year-olds is quite poor. In nearly 20% of the cases, infants were regarded as not at all resembling the parent - whereas this happened in less than 5% of the cases for both 8-year-olds (as shown by a re-analysis of Bressan and Dal Martello's data) and adult children (Bressan & Bellini, unpublished data).

Overall, our results are consistent with the idea that it is in the genetic interest of fathers to produce offspring lacking distinctive signature cues, as suggested by the modelled comparison of the fitness of fathers who mark their progeny with that of those who do not (Bressan, 2002). It is true that a father gains no fitness from taking care of any offspring that result from his spouse's affairs, but it is equally true that he gains fitness if children that he sires with other women are cared for by their social fathers; thus, the selective advantage that social fathers gain from accurate offspring discrimination is exactly offset by the disadvantage to the cuckolders. Men, often the same men, fill both roles.

Looking like the social father is always beneficial, but looking like the genetic father is not. It follows that a truly efficient evolved strategy would rely not on phenotypic labeling, but on an automatic overestimation of child-parent resemblance on the mere basis of belief in relatedness - which would be twice as effective if accompanied by a symmetrical underestimation on the basis of belief in unrelatedness. A cognitive bias of precisely this form has been empirically demonstrated in neutral judges of both sexes (Bressan & Dal Martello, 2002). Although paternal identifiers should not evolve, a weak resemblance may hence be better than none at all - a degree of resemblance not large enough to permit unambiguous identification of a baby's father, but large enough to provide, whenever the domestic father is also the biological

one, some grounds on which allegations of father-infant resemblance can be based. Such allegations are widespread across cultures (Daly & Wilson, 1982; Regalski & Gaulin, 1993), and by reassuring fathers and thus increasing paternal investment, they certainly benefit children, mothers, and all those who share any genetic interest with them.

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