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## Why babies look like their daddies: paternity uncertainty and the evolution of self-deception in evaluating family resemblance

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**Abstract** It has been suggested that in a socially monogamous system where fathers invest in their mate's offspring but paternity is far from certain, it will be adaptive on the part of infants to conceal their father's identity; but the opposite claim has also been made that this is against the genetic interests of the fathers, and a high frequency of adulterine births will select instead for paternal resemblance. In this article, I present a simple theoretical model that suggests that neonatal anonymity benefits fathers, mothers, and children. Once anonymity becomes established, however, all babies start paying the cost of paternity uncertainty, that is, the reduction in paternal care due to fathers not knowing whether they have truly sired their mate's offspring. By diminishing the fitness of babies, such a cost bounces back as lowered fitness for parents as well. We should then expect the evolution of maternal strategies directed to decrease paternity uncertainty, in the form of instinctive and unsolicited comments on babies' resemblance to their putative fathers. In contradiction to the widespread belief that it would be in fathers' interest to be skeptical of these allegations, the model suggests that, under conditions of infant anonymity, fathers will actually promote their own fitness by believing their spouses.

**Keywords** Resemblance · Confidence of paternity · Parental investment · Kin recognition · Evolutionary psychology

One of the most important things to realize about systems of animal communication is that they are not systems for the dissemination of the truth.

Robert Trivers, *Social evolution*

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Human babies do not look much like their parents, and it can be argued that, from an evolutionary stance, they have good reason not to. In socially monogamous mating systems such as our own, where paternity is nevertheless far from certain, babies may gain from displaying their father's phenotypic traits, but the putative father and the biological father will not always coincide. On the assumption that fathers have been selected to invest in their genetic progeny only, adulterine babies will suffer a cost, which may range from neglect to extreme forms of abuse, such as infanticide (Daly and Wilson 1984). It has been suggested that, given the severity of this cost, a proportion of extra-pair conceptions larger than 1 in 10 would be enough to favor concealment of paternity (Pagel 1997). More specifically, the fitness of babies with a "badge" or label of paternal identity would be less than the fitness of babies without a badge. Yet, the opposite claim has also been made: according to Johnstone (1997), when the frequency of adulterine births is high the genetic interests of fathers overcome the lower incentive of babies to reveal their identity, selecting *against* concealment of paternity.

It is clear that, in general, the genetic interests of the baby and those of its father partly overlap, but they do not necessarily match. The baby is perfectly related to itself, but related by only one-half to either parent. Both father and child will try to maximize their personal fitness, even at some cost to each other in the event of a conflict of interest. The question, then, is this: it is fine that the baby wants to conceal its father, but does the father want to be concealed? Human babies are anonymous, but how have they managed to become or remain such, if the interests of their fathers call for a "baby-looks-like-father" strategy?

### A model of father–infant resemblance: father's point of view

Investing so little at the time of copulation, males are selected to try to pair with a female whose offspring they

will help to raise, while at the same time attempting to copulate with other females whose young they will not raise [in the quintessential prose of Trivers (1985)]. Such a strategy, however, strikes back by causing males to run the risk of investing in young that are not their own. The implications make for an interesting paradox. On the one hand, fathers who mark their progeny for subsequent identification will recognize adulterine children and neglect them, which will confer an advantage to genes coding for a paternal identifier. On the other hand, fathers who do not mark their progeny will avoid having their “satellite” children recognized as adulterine and neglected, which in turn will confer an advantage to genes coding for phenotypic anonymity.

Pagel (1997) has proposed a simple theoretical model to investigate the evolutionary interests of the baby in matters of paternal resemblance. Adopting the same logic and terminology, we can rewrite his equations to illustrate the evolutionary interest of the father, as follows:

$$\begin{aligned} W_B &= m + (1-m) [(k + (1-k)(1-s_1)) \\ &\quad - (1-k)q(1-s_1) - (1-k)(1-q)(1-s_2)] \\ W_A &= m + (1-m) [(k(1-s_2) + (1-k)(1-s_2)) \\ &\quad - (1-k)(1-q)(1-s_2) - (1-k)q(1-s_1)] \end{aligned} \quad (1)$$

where  $W_B$  is the fitness of fathers producing babies with a badge (hereafter, B-fathers), and  $W_A$  is the fitness of fathers producing babies without a badge, that is, anonymous (hereafter, A-fathers).<sup>1</sup> The model's parameters are listed in Table 1.

The general assumption underlying the argument is that the fitness that a parent accrues through each offspring is a function of the amount of investment received by that offspring. In the proportion  $m$  of marriages that are strictly monogamous, all fathers have a fitness of 1. In the  $1-m$  marriages in which females are promiscuous,  $k$  is the proportion of offspring in which the domestic (or putative) father is also the biological father. In these cases, B-fathers will have a fitness of 1, but A-fathers will have fitness  $1-s_2$ , where  $s_2$  is the effect, on the father's fitness, of the reduction in paternal care due to paternity uncertainty. It has been shown, for example, that a father will diminish his investment in the young if he has not had exclusive mating access to the female (see for a brief review Clutton-Brock 1991). Of course, B-fathers will not pay this cost because the phenotypic badge constitutes evidence that they have indeed sired this baby.

On the  $1-k$  occasions in which domestic father and biological father do not coincide, we ought to consider separately the repercussions on the fitness of males in either role. If we limit our attention to paired individuals, each male is at the same time a domestic father and a biological father:  $m$  times in monogamous marriages and  $k$  times in promiscuous marriages, both roles having as re-

**Table 1** The model's parameters

Parameter	Description
$m$	Proportion of strictly monogamous marriages
$k$	Proportion of offspring whose domestic and biological fathers coincide
$q$	Proportion of fathers who mark their children
$s_1$	Repercussion, on parental fitness, of the reduction in baby's fitness associated with its carrying the wrong badge, and being thus recognized as adulterine
$s_2$	Repercussion, on parental fitness, of the reduction in baby's fitness associated with its being phenotypically anonymous, and thus engendering paternity uncertainty
$a$	Ratio between the reduction in parental care given to anonymous babies ( $s_2$ ) and paternity uncertainty ( $1-k$ )

cipient the same offspring. In the  $1-k$  cases in which a male is a biological (but not domestic) father, B-fathers have fitness  $1-s_1$ , where  $s_1$  is the effect on the father's fitness of the cost suffered by a “satellite” baby who (by virtue of its carrying a badge) is recognized as adulterine. In the same  $1-k$  cases, the “satellite” babies of A-fathers (because of their phenotypic anonymity) will not be recognized as adulterine and will be spared  $s_1$ . However, their anonymity will constitute grounds for the disinvestment linked to the paternity uncertainty of their domestic fathers: therefore, in these circumstances A-fathers have fitness  $1-s_2$ .

In the cases considered so far, the portions of fitness deriving from the various situations are added together in the appropriate proportions. In the  $1-k$  cases in which a male is a domestic (but not biological) father, however, his fitness is not augmented but decreased. If each parent has a fixed total parental investment, which is allocated between offspring (e.g., Maynard Smith 1980), it is reasonable to posit that the amount given to an unrelated child is ideally subtracted from the amount that should have been given to a related child. The adulterine child who is successfully raised to reproductive maturity takes the place of a biological child, thus robbing the domestic father of the same amount of fitness that the latter would have donated. Now, such an adulterine baby can either carry some other man's badge and be thus recognizable (in the  $q$  cases in which it has been conceived with a B-father, where  $q$  is the proportion of B-fathers in the population) or be anonymous (in the  $1-q$  cases in which it has been conceived with an A-father), and this will affect its destiny identically whether it happens to be born in an A- or a B-household. On the  $1-k$  occasions in which a male's spouse presents him with an adulterine baby, the fitness of *all* fathers is decreased by  $1-s_1$  in  $q$  cases, and by  $1-s_2$  in  $1-q$  cases; Eq. 1 thus becomes

$$\begin{aligned} W_B &= m + (1-m) [k + (1-k)(1-s_1)] \\ W_A &= m + (1-m)(1-s_2) \end{aligned} \quad (2)$$

<sup>1</sup> Pagel (1997) presents two basic variants of his “baby's viewpoint” model, which differ as to whether a very small metabolic or other physiological cost is paid by the baby either in producing the badge, or in producing anonymity. For simplicity, the model presented here introduces neither cost; this does not affect the conclusions.