

CHAPTER 3

THE PSYCHOLOGY OF PARENTING IN EVOLUTIONARY PERSPECTIVE AND THE CASE OF HUMAN FILICIDE

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Child rearing is effortful. Indeed, the parental investment of time, effort, and resources in children, and the incurring of risk on their behalf, have constituted the major lifetime commitments of most people throughout most of human history. But in spite of the effort, children are fervently desired: Even in industrial societies that have undergone the demographic transition from high to low fertility, a substantial majority of adults want children.

Not only is child rearing in general effortful, but in a low-fertility species like *Homo sapiens*, each child-rearing episode consumes a major proportion of the parent's lifetime efforts. In natural-fertility populations living primarily by foraging, a woman who survived until menopause was likely to give birth to only about 4 or 5 children in her lifetime and to nurse each of them for several years (e.g., Lozoff *et al* 1977; Howell, 1979; Blurton Jones, 1989). Low fertility and wide birth-spacing must have characterized our species throughout its long pre-agricultural past.

There is variation among societies in the relative involvement of mothers and fathers in childcare and other forms of parental investment, and this variation warrants study in terms of the differential utilities of women's and men's parental efforts (for sexual division of labor and parenting duties among foraging peoples, see West and Konner, 1976; Hill and Kaplan, 1988a,b; Hewlett, 1988; Blurton Jones, 1989). This variation should not obscure such regularities, however, as the fact that human mothers everywhere assume the major responsibility for physical care-

giving and nourishment of small children, and they do so regardless of whether the conjugal division of labor is such that husbands compensate in spheres other than childcare.

Parenting constitutes a major domain of human effort, then, but it is a remarkably underrepresented domain in discussions of human motivation (Daly and Wilson, 1988b). Arguably, psychology has neglected the subject of parental motives for want of a theoretical framework within which to understand variations therein. The requisite theoretical framework is that of evolution by selection.

EVOLUTIONARY PSYCHOLOGY OF DISCRIMINATIVE PARENTAL SOLICITUDE

Few psychologists would quarrel with the claim that the psyche has evolved by selection, but until recently, too few have derived direction or inspiration from what evolutionary biologists know about the process of evolution by selection. Even comparative psychologists interested in parental motivation have focused mainly on demonstrations of the proximate causal roles of hormones and the stimulus properties of the young in the establishment and maintenance of maternal responsiveness in a few species, without addressing why natural selection has designed the motivational and information-processing mechanisms subserving parental behavior to respond as they do.

Parental behavior is not reflexively evoked by infantile conspecifics. It is instead complexly contingent, and the particular ways in which it is contingent have an adaptive logic as a result of a history of selection. An obvious example concerns the fact that evolved parental motivational systems are typically sensitive to cues of individual identity and not simply to species-typical cues of infancy, since one important determinant of whether a youngster is a suitable vessel for parental investment is whether it is the parent's own (Daly and Wilson, this volume). Moreover, a parent might be expected to behave discriminatively even among its own young according to cues that were predictive of fitness returns in the past. Although offspring are a parent's means to genetic posterity, parent-offspring conflict is an endemic feature of sexually reproducing organisms because the allocation of resources and efforts that would maximize a parent's genetic posterity does not necessarily maximize a particular offspring's (Trivers, 1974, 1985). Parental psyches that have been shaped by selection are therefore discriminative psyches, investing parental effort preferentially where it was likely to have yielded the greatest returns during evolutionary history.

Psychology has been concerned with the characterization of behavioral control mechanisms, not with their evolution, and it is certainly possible for psychologists to discover mechanisms of parental psychology by observation and experiment without recourse to evolutionary thinking. However, psychology's task can be greatly facilitated by consideration of the natural selective circumstances that have shaped the mechanisms modulating parental inclinations and behaviors. This is not to say that such evolutionary theorizing can substitute for empirical research, but simply that theory can suggest what adaptations would be useful under one or another set of conditions, and thus help us decide what sort of mechanisms we should be looking for.

Consider, for example, variability in parental commitment to the defense of helpless young. A simple evolutionary theoretical insight is that fitness benefits will accrue to parents whose psyches assess available predictors of offspring's eventual contributions to parental fitness and adjust defense accordingly. A stickleback fish guarding a nest full of eggs will stand his ground against an approaching predator longer, and dart at the predator more bravely, the more eggs he has in the nest (Pressley, 1981). In effect, the greater fitness value of a larger brood elevates the statistical probability of death that the stickleback is prepared to accept. One correlate of brood size, which might be the cue modulating fear versus bravery in this context, is carbon dioxide production by the eggs, and if so, then it is likely that this cue will prove to mitigate fearfulness only in egg-guarding males. One would be unlikely to discover such contextual variation in the controls of fearfulness without the basic Darwinian insight that even personal survival is a subordinate objective to that of genetic posterity. Because fitness is the ultimate arbiter of adaptation, motivational systems have evolved to respond to whatever cues are predictive of the fitness consequences of behavioral options, and realizing this can direct even the most mechanistically reductionist student of psychological processes to better hypotheses.

A SELECTIONIST PERSPECTIVE ON DISCRIMINATIVE PARENTAL SOLICITUDE

Parents "invest" in their young in various ways such as depleting their bodily reserves in lactation, allocating their time to protection and care, and suffering risks to their own lives on behalf of the young. These and other physiological processes and behavioral activities are all instances of "parental investment" (Trivers, 1972, 1974): their common denominator

is that they all entail the parent's contributing to the expected fitness of the young who receive the investment at some cost to the parent's expected fitness through other avenues. Moreover, the "strategic" commonality among these various forms of investment provides a rationale for expecting that there will be some commonality of causation as well. Any offspring whose characteristics make it a good bet to yield fitness for one sort of parental investment will usually be a good bet for other sorts, and divestment from lost causes should apply to all manner of parental investments, too. In other words, we may expect parental motivational systems to contain processes and structures that function as if mediated by a unitary parameter (an "intervening variable"¹), which is influenced by a variety of parental, offspring and situational cues of offspring-specific expected fitness, and which influences in its turn the whole gamut of parental activities. This intervening variable might be called offspring-specific parental love or solicitude.

Our proposal, then, is that the individualized love that parents feel for their offspring varies between individuals and over time because such love is an evolved proxy for the expected contribution of each offspring to parental fitness. If this is so, then offspring-specific parental love may be expected to vary according to:

- (1) the degree or certainty of parent-offspring relatedness,
- (2) phenotypic attributes of the child predictive of its eventual fitness,
- (3) situational predictors of an offspring's fitness value, and
- (4) the alternative reproductive and investment opportunities of the parent.

These considerations bear directly on questions of how parents are likely to perceive costs and benefits of their various options for allocating reproductive effort over the lifespan of both parent and offspring (e.g. Andersson *et al.*, 1980; Pugesek, 1983; Daly and Wilson, 1981, 1984, 1988a,b,c; Knight and Temple, 1986; Montgomerie and Weatherhead, 1988; Redondo, 1989; Thornhill, 1989).

1. Genetic Relatedness

If a parent were to have any grounds for doubt that a putative offspring were indeed his or her own, then this doubt would warrant an effective

discounting of the parental perception of the benefits (or costs) of any increments (or decrements) in that offspring's expected fitness. The coefficient of relatedness (r) between parent and offspring is 0.5 if the parents are unrelated, but potentially higher in the case of inbreeding and potentially lower in the case that the putative relationship is uncertain.

The problem of misattributed parenthood is sexually asymmetrical in organisms with internal fertilization. This asymmetrical risk of cuckoldry is probably one reason for the rarity of significant paternal investment in mammals; in birds the males may run the same risks but in most species males participate anyway. Recent genetic studies of biparental, "monogamous" bird species in the field are revealing some possibly surprising levels of non-paternity (Westneat *et al.* 1990). Do males then adjust their parental efforts in relation to probabilistic indicators of paternity? At least two studies (Møller, 1988b; Davies, 1990; Hatchwell and Davies, 1990) indicate that they do, the males in both cases reducing their posthatching feeding efforts in relation to earlier lapses in their surveillance of their fertile mates during the egg-laying phase.

In biparental birds, unlike biparental mammals, females also incur some risk of misdirecting parental investment to rivals' offspring in natural situations, as a result of the occasional "dumping" of eggs in conspecific nests (e.g. Gowaty and Karlin, 1984; Brown, 1984; Quinn *et al.* 1987). We are not aware of evidence that the victims of intraspecific brood parasitism reduce their own investment, but interspecific parasitism can inspire abandoning the clutch altogether.

2. Phenotypic Attributes and Reproductive Value of Offspring

The reproductive value (RV) of the offspring refers to its own expected fitness given its age, sex, and any other aspects of its phenotype that are predictive.

(a) Age of offspring

If, as in many nestling birds, the daily mortality risk of immatures is high and largely unrelated to their individual phenotypes, then simple age is a major determinant of RV. This is so because each day survived increases the nestling's likelihood of fledging and eventually breeding: a songbird 10 days after hatching has a very much higher expected future fitness than a new hatchling, even though both are equally nestbound and helpless. In such a case, parental valuation of the young may be expected to increase conspicuously over days. There is a large body of empirical

¹ Miller (1959), argued that motivational theorists are justified in postulating abstract constructs like "thirst", if the task of summarizing the effects of several independent variables upon several dependent variables is simplified by assuming that the effects are mediated through a single "intervening variable".

work, mostly involving assessment of parental willingness to incur risk to self in defense of eggs and nestlings, and the results are for the most part confirmatory (reviews by Montgomerie and Weatherhead, 1988; Redondo, 1989).

(b) *Sex of offspring*

Fisher (1958) argued that equal investment in sons and daughters is an evolutionarily stable strategy (*sensu* Maynard Smith, 1978) because the total RV of males must equal that of females in a sexual population, with the result that selection would favor investing in whichever sex was receiving less total parental investment in the population as a whole. This theorem has been amply supported, and is the foundation of an expanding body of empirical and theoretical work on sex allocation (*e.g.* Charnov, 1982; Stamps, 1990).

Fisher's analysis indicates that a generalized favoring of one sex or the other cannot be adaptive and species-typical, but it does not rule out the possibility of adaptive investment decisions² in relation to offspring sex. An important addendum to Fisher's theory was Trivers and Willard's (1973) demonstration that individual parents might profit by investing preferentially in one or the other sex notwithstanding the population equilibrium. In polygynous species, for example, males exhibit a higher variance in fitness than do females, so from a parent's point of view extra investment in a son of good quality may yield greater returns (measured in grandchild production) than comparable investment in a daughter of good quality, while investment in a son of less than average quality may be wasted. Depending upon the sex determining mechanisms of the species, parents may have little control over the sex of zygotes at fertilization, but they can and do invest differentially in daughters versus sons after birth, sometimes exhibiting adaptive sex-biased investment of the sort that Trivers and Willard envisioned (*e.g.* Clutton-Brock *et al* 1985; Austad and Sunquist, 1986).

²We refer to "decisions" without necessarily implying consciousness or rationality. Natural selection creates mechanisms of adaptive contingent response such that a seed might be said to "decide" when to germinate in response to moisture cues, *etc.* Some of the "decisions" we discuss, such as whether to raise a child or to abandon it, surely are affected in complex creatures like *Homo sapiens* by some sort of mental construction of hypothetical alternative scenarios, but even this sort of scenario-building may or may not be accessible to consciousness or to retrospective reconstruction. The extent to which "decision" processes are capable of exploiting particular kinds of information is in each case an empirical issue.

(c) *Health status of offspring*

Investment in moribund offspring is wasted investment, and we might expect evolved motivational mechanisms to be such as to avoid it. Some birds eject cracked eggs from the nest, and some parturient rodents assess the responsiveness of their newborns in the process of licking up the birth fluids, eating or rejecting the stillborn on the spot. However, the differential costs of wasting a little time on the moribund versus prematurely abandoning a temporarily unresponsive offspring may select for conservative decision rules, producing such apparently maladaptive phenomena as continued transport of dead babies by primate mothers. More generally, parents might be expected to modulate investment in relation to probabilistic cues of offspring survival and reproductive success, rather than confining themselves to all-or-none decisions. Alexander (1979) has argued that parents should have evolved to be sensitive to offspring "need", and it is important to note the technical and nonintuitive meaning that he attaches to the word "need", namely the offspring's capacity to transform parental investment into personal fitness. Hopelessly deformed young or runts, for example, may be desparately "in need" in ordinary parlance, but not in Alexander's special sense in which need is predicated upon the potential to promote one's fitness.

In principle, cues of offspring RV could be accessible to the parent not only in the offspring's own phenotype, but also in characteristics of the mate indicative of the genetic quality of one's young with respect to phenotypic attributes not yet expressed (Montgomerie and Weatherhead, 1988). Thus, for example, one might work harder to care for offspring (and incur elevated costs to one's own survival prospects) when one's mate is perceived as being an especially good one, and care less well for the young of an apparently poor mate, even if offspring cues and own condition were identical in the two cases. Such effects have been shown in at least a couple of avian species (Burley 1986; Medler 1988a) and may be widespread. An analogous sensitivity to cues of male quality is shown by a female scorpion only deciding how many eggs to fertilize from sperm stores from her most recent mate before remating (Thornhill, 1981); in this case young are not the recipients of differential parental investment after the zygote stage, but females do analogously allocate their reproductive efforts with consideration of male qualities presumed to be predictive of the genetic quality of offspring.

3. Situational Predictors of Fitness Value of Offspring

Irrespective of the quality of the offspring, circumstances may portend poor survival prospects. If food is scarce and parents would only be risking their own lives by persisting in efforts to rear dependent offspring, the young may be abandoned without any chance of surviving on their own. Food shortage may reduce the age-specific reproductive value of the young by affecting maternal condition or by starvation, or by increasing vulnerability to pathogens or to bad weather. Storms or an abundance of parasites sure to attack the young later or other such local factors might warrant adaptive abandonment or reduced investment even when food is abundant, and characteristics of the construction and locale of the breeding site as well as the type and density of predators will also affect the probability of rearing the young to maturity, and hence the optimal level of investment (Montgomery and Weatherhead, 1988; Redondo, 1989).

4. Alternative Reproductive Options of the Parents

The decision that present circumstances are not favorable for the rearing of young is an implicitly relative one. Some more promising alternative must, at the least, be a possibility in the future, or else the present decision is futile. A parent's options are affected by its own age, sex, quality, and situation (including variations in demography of the local population), which in turn affect the parent's residual reproductive value by affecting its probability of surviving, of re-mating, and of successfully rearing additional broods (e.g. Pugesek, 1983, 1987, 1990; Clutton-Brock *et al.* 1985; Wallin, 1987). Moreover, in some species including our own, new young may be started before investment in their siblings ends, so that parents may have to consider the detrimental impacts of their investments in the present offspring on both their older offspring and their potential future offspring (e.g. Zalas and Breitwisch, 1989; Weatherhead and McRae, 1990).

Furthermore, in biparental species in which a second parent's contributions are not so valuable as to double the expected offspring production of a single parent, a potential conflict of interest arises since either parent might prefer that the other tend their brood while the desenter pursues additional fitness prospects elsewhere (Maynard Smith, 1977; Westneat, 1988; Lazarus, 1990). Existing asymmetries in residual reproductive value and "bargaining power" may affect the probability that one parent will desert or otherwise exhibit reduced parental investment (e.g. Beissinger and Snyder, 1987; Rogers, 1988; Zalas and Breitwisch, 1989; Davies, 1990; Hatcherwell and Davies, 1990; Weatherhead, 1990).

MEASURES OF PARENTAL EFFORT

It is not easy to test the impacts of these cues of expected fitness returns on variations in parental valuation of offspring. One complication is that changes in RV can be hard to separate from concomitant change in offspring dependency and needs. A measure of parental investment that lends itself particularly well to the development and testing of evolutionary models of parental discriminative solicitude is the defense of young whose vulnerability holds fairly constant while their RV varies.

In birds, predation upon eggs and unfledged young is often intense, such that there is a dramatic increase in offspring RV over days. As noted above, many studies indicate that parental willingness to incur risk to self in defending the young tracks this increase. Moreover, insofar as nest defense decisions entail an effective trade-off between parental valuation of the young and of oneself, parents should have evolved to be sensitive to their own reproductive prospects as well as the young's, and there is some evidence that they are (Montgomery and Weatherhead, 1988; Redondo, 1989; Thornhill, 1989). However, the impact of the parent's own RV upon its parental investment decisions is less clear than the impact of the offspring's RV. Efforts to show effects of parental RV have been somewhat bedeviled by the fact that aging animals change in other possibly relevant ways than just declining in RV. Greater parental effort with age can be confused with effects of experience that make the parent more effective without really incurring greater risk to self or otherwise investing more, for example. However, parental experience effects do not seem to explain away increases in parental effort with age in junglefowl (Thornhill, 1989) or California gulls (Pugesek, 1983, 1987).

Unfortunately, although parental defense against a standard threat provides a convenient and logically compelling metric of the parent's present valuation of the young, it is not necessarily a metric by which one can compare the parental commitment of mother versus father. Despite the common causal core of offspring-specific (or brood-specific) parental solicitude, there are relevant considerations that are specific to particular types of parental investment, too. Optimal incubation effort, for example, will be a different function for mother versus father if sexually selected brightness of males means that incubation is a lower-risk activity for the more cryptic females. Which parent plays the greater role may then be reversed in the domain of aggressive defense of the brood if the sexes differ in size or weaponry in ways that affect their respective effectiveness as defenders (e.g. Andersson and Wiklund, 1987; Wallin, 1987; Breitwisch, 1988). Such differences may coexist with

sexual similarity in other spheres such as in efficiency of feeding offspring.

It is difficult and often laborious to determine the costs to parents and benefits to the young of feeding, warming, tutelage and other such activities, over the range of variation that actually occurs. If parents deliver food to growing young at increasing rates, does this necessarily reflect increasing valuation of those young because of their growing RV? Increased delivery rates might follow from increased offspring demand even if parents valued the young identically. Even demonstrating that parental care is in any sense costly can require a major research effort, and the task of determining how nearly optimal are the actual investment decisions of parents is vastly greater. It is because of these complications that research on parental investment has been concentrated on the limited but relatively convenient domain of parental defense.

Paradoxically, infanticide can be used as another assay of parental solicitude with some of the same advantages as parental defense. Any factor that may be expected to influence parental investment decisions should also be relevant to the likelihood of lethal divestment, whether as a result of the parent's strategic termination of a particular reproductive episode or as a result of a dangerous shortfall of concern for the offspring's welfare.

INFANTICIDE IN *HOMO SAPIENS*

Consideration of adaptive parental decision-making provides a framework for the analysis of the circumstances in which human parents decide not to raise a particular offspring. If parental psychology has been shaped by a history of selection, then we may expect to find a correspondence between the circumstances and rationales of infanticide, as revealed in the ethnographic record, and the circumstances in which evolutionary theories predict mitigation of parental solicitude, as discussed above.

People of most cultures recognize that parents will sometimes choose not to raise a child. The factors that they consider relevant to such a decision vary, to some degree, from one society to another, but the great majority of ethnographic accounts of infanticide in nonindustrial societies appear to reflect a strategic allocation of lifetime parental effort: The principal relevant variables are considerations of genetic relatedness, the child's fitness prospects as indicated by offspring quality and by particular local conditions relevant to the child's survival prospects, and the parents' alternatives (Howell, 1979; Mull and Mull, 1988; Bugos and McCarthy, 1984; Daly and Wilson, 1984; Scrimshaw, 1984; Schepel-Hughes, 1985; Hill and Kaplan, 1988b). In other words, people's infanticidal decisions

can be reviewed in relation to the same themes under which we just discussed discriminative parental solicitude in general.

1. Genetic Relatedness

In people, as in all mammals, the issue of relatedness of child and putative parent is a sexually-asymmetrical issue: maternity is a fact and paternity an attribution (Daly and Wilson, 1982). Suspicion or knowledge of nonpaternity may then be a reason for male disinclination to raise a child. Recurring rationales for infanticide in the ethnographic literature include claims of adulterous conception, impregnation by a prior husband, and phenotypic cues of a nontribal sire.

2. Phenotypic Attributes and Reproductive Value of Offspring

(a) Age of offspring

A child's expected contribution to its parent's fitness is directly related to the child's own expected fitness or RV.³ In the absence of mishap, one's RV increases steadily from birth until at least puberty. This is so primarily because surviving to maturity cannot be taken for granted. With modern medicine, the early increase in RV is muted by declines in infant and juvenile mortality, but where life-historical mortality and fertility are closer to the levels that must have prevailed for most of human history, the prepubertal increase in reproductive value is not trivial.

We would thus expect parental feelings to have evolved such that parents will seem to value offspring increasingly with age, and we might therefore expect to see an age-related decrease in the likelihood of lapses of parental solicitude. As in the avian cases discussed earlier, increased parental solicitude with offspring age may be difficult to detect because the offspring's dependence is waning at the same time, but parental valuation of the young might in principle be assayed by the parent's declining willingness to

³Fisher's (1958) RV is usually conceived of as the phenotype-specific expected reproductive success: classical Darwinian fitness or "direct" fitness in Browns' (Brown and Brown, 1981) terminology. A more general concept of "inclusive fitness value" (IFV) would incorporate "indirect" fitness effects as well, i.e. the organism's expected impacts upon the posterity of its genes through its effects on collateral as well as descendant kin. A child's expected contribution to its parent's inclusive fitness is directly related to the child's own IFV. Reference to the child's RV as indicative of its fitness value from the parental perspective is seldom seriously misleading, however, since, in general, we would expect that factors associated with an increase in RV would be associated with an increase in IFV, too.

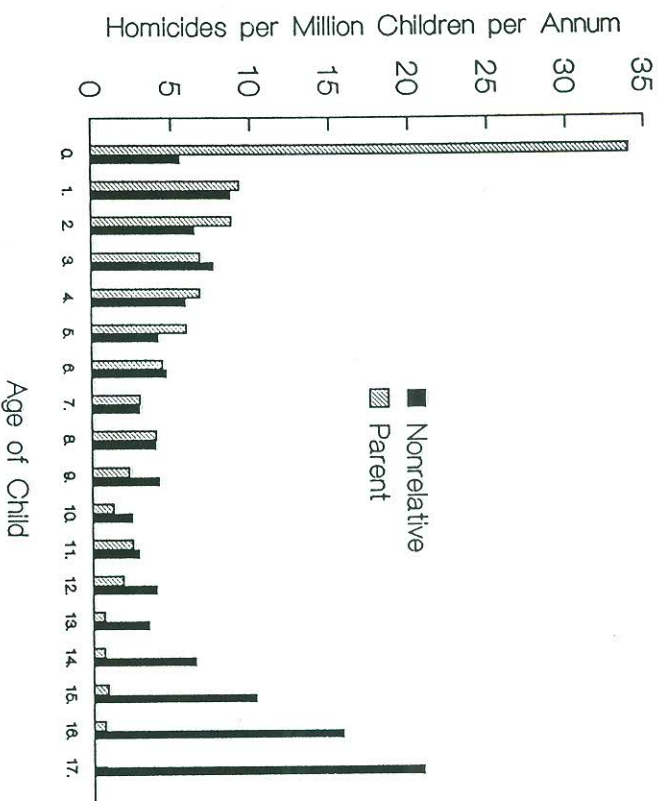


Figure 1 Age-specific rates of homicide victimization among Canadian children 1974-1983, perpetrated by birth parents (N = 352 victims). (Modified from Daly and Wilson 1988a).

tolerate or expose the young to lethal risk. One apparent manifestation of such an age-related change in parental valuation is a monotonic decrease in the risk of filicide (Figure 1), which continues to near zero as the offspring approaches maximal RV in young adulthood. It is especially striking that children become increasingly immune from parental lethal action as they mature, since this maturation entails increasing competitiveness in their interactions with non-relatives, and an increasing overall risk of becoming involved in lethal interpersonal conflict, both as killer and as victim (Wilson and Daly, 1985; Daly and Wilson, 1990).

The steep decline in risk of filicide from the first to the second year of the child's life is expectable upon two considerations: (1) that a major share of the prepubertal increase in the child's RV occurs within the first year postpartum, and (2) that insofar as parental disinclination reflects a "strategic" assessment of the reproductive episode, an evolved assessment

mechanism should be such as to terminate hopeless ventures as early as possible.⁴

(b) Sex of offspring

Female-selective infanticide occurs in many human societies (Daly and Wilson, 1984; Irwin, 1989; Miller, 1988; Schiefelhövel, 1989), whereas unequivocal accounts of male-selective infanticide are hard to find. The rationale for a preference for sons is not immediately obvious, since Fisher's sex ratio theory would seem to imply that preference for either sex would be evolutionarily unstable.

Resolution of this paradox may depend upon the Trivers-Willard hypothesis of adaptive preferences for one offspring sex in certain segments of a population offset by preference for the other elsewhere (Hrdy, 1987). Dickemann (1979) was the first to show that female-selective infanticide is status-graded in stratified societies in which sons are potential polygamists (whether by recognized marriage or by concubinage) and to link this status-grading to hypergyny and dowry competition; thus, human parents are Trivers-Willard strategists. A missing element was any evidence for a switch to preferential treatment of daughters and male-selective infanticide in the lower strata, but of course the behavior of the lower strata is less well documented than that of the wealthy and powerful. Others have since documented the coexistence of a preference for sons in wealthier or otherwise advantaged people and preferential treatment of daughters by the poor, people seeming to flexibly assess and respond to the future marital and reproductive prospects of sons versus daughters (e.g. Cronk, 1991; Mealey and Mackey, 1990; Voland, 1984; Abernethy and Yip, 1990). In extreme cases, such differential treatment amounts to sex-selective filicide by neglect of children of the disvalued sex.

(c) Health status of offspring

It would be an ill-designed organism that delayed or jeopardized future reproduction in order to nurture present offspring whose own reproductive prospects were nil. Thus, although an evolved parental psychology should be responsive to offspring need and dependency, it must be capable of recognizing when further effort will be wasted. Prevalent rationales

⁴Organisms that have the means to abort or resorb embryos do so discriminatively in response to cues of the fertility of maturing them. Consciously felt inclinations to abort on the part of pregnant women appear to reflect the same strategic logic, responding to the same predictor variables as does infanticide (e.g. David, Dytrych, Matejcek and Schuller, 1988; Devereux, 1955).

for infanticide in the ethnographic literature include conspicuous deformity or illness of the newborn (Dickeman, 1975; Daly and Wilson, 1984). Where the failing infant is not directly killed or abandoned, the mother's emotional commitment to the child is likely to be muted with resultant mortality risk from lesser vigilance and care (e.g. Scheper-Hughes, 1985).

3. Situational Predictors of Fitness Value of Offspring

In Daly and Wilson's (1984) review of infanticidal rationales in the ethnographic literature, the largest number of cases fell under this rubric. Famine is an obvious reason for abandoning a newborn, and the death of either parent may disincite the survivor to try to go it alone. An unwed mother finds herself in a situation analogous to the widow's, and a large proportion of neonaticides occur in such circumstances.⁵ A baby born to an unwed woman is often a poor fitness prospect by virtue of the mother's limited present ability to raise it, because it compromises the mother's marital prospects (issue 4, below), and because if she does acquire a husband, he is likely to discriminate against it (issue 1, above).

A common rationale for infanticide concerns the mother's present incapacity to cope with the demands of child rearing. One circumstance indicative of maternal overburdening, and a frequently cited reason for infanticide, is the birth of twins; the victim might be the second born, the weaker, or the female. Another circumstance representing a decision about the allocation of scarce maternal resources is that in which lactational suppression of ovulation has failed, so that a baby is born too soon after the last one. In this situation, the older child of greater RV is favored over the newborn.

4. Alternative Reproductive Options of the Parents

The alternatives to a present reproductive venture shrink with time, a fact of much consequence for women: the older the new mother the lesser her residual RV. So one would expect a woman to be less and less inclined, as her reproductive years slip away, to devalue a present offspring in terms of its compromising effects on her future. It follows that the risk of maternally perpetrated infanticide might decline as a function of maternal

⁵The mother is the parent with the greater allocation of parental effort at least until the infant is weaned, and is thus the parent who might be expected to be under the greater incentive to terminate lost causes. It is worth noting that although neonaticides are generally viewed as acts by the mother, they are likely to be effected by abandonment rather than a directly lethal act, and the father in such a case abandons the child no less than the mother.

age, and so it does (Bugos and McCarthy, 1984; Daly and Wilson, 1984; 1988a,c).

We would expect that many of the variables that are relevant to changes in maternal solicitude (or lapses therein, as in the case of maternal filicides) should be similarly relevant for fathers. The paternal case, however, is different from the maternal one, in at least three ways, all of which suggest that there will be a sexual asymmetry in the time-course of changes in parental solicitude:

- (1) Women's reproductive life spans end before those of men, so the utility of alternative reproductive efforts declines more steeply as a function of own age for women than for men.
- (2) Dependent children impose different opportunity costs on mothers and fathers, a nursing infant constraining mother's immediate alternative reproductive prospects much more than father's, for example, and the magnitude of this differential impact upon mother versus father declines with time since birth.
- (3) Phenotypic and other evidence of paternity may surface after infancy and is expected to be relevant to paternal, but not maternal solicitude.

These three considerations suggest that a mother's valuation of a child relative to her valuation of herself is likely to rise more steeply with time since the child's birth than is the corresponding quantity for the father. If filicides constitute a sort of reverse assay of parental solicitude, it follows that filicide rate should decline more steeply for mothers than for fathers. Figure 2 presents data confirming this prediction.

PARENTAL SOLICITUDE AND MARITAL CONFLICT

By engaging in sexual reproduction and by the cooperative rearing of offspring, couples forge a powerful commonality of interest at the fundamental level of fitness. This shared interest is analogous to that existing between genetic relatives, but the genetic interests of an exclusively monogamous pair coincide even more closely than those of blood relatives since each's fitness interests are vested in their mutual progeny (Alexander, 1987). However, two considerations act against the evolution of perfect harmony in mated pairs: (1) the possibility of extra-pair reproduction, and (2) the partners' nepotistic interests in the welfare of distinct sets of collateral kin.

The issue of a putative father's disinclination to invest in his wife's children from a prior union or from an adulterous conception was noted

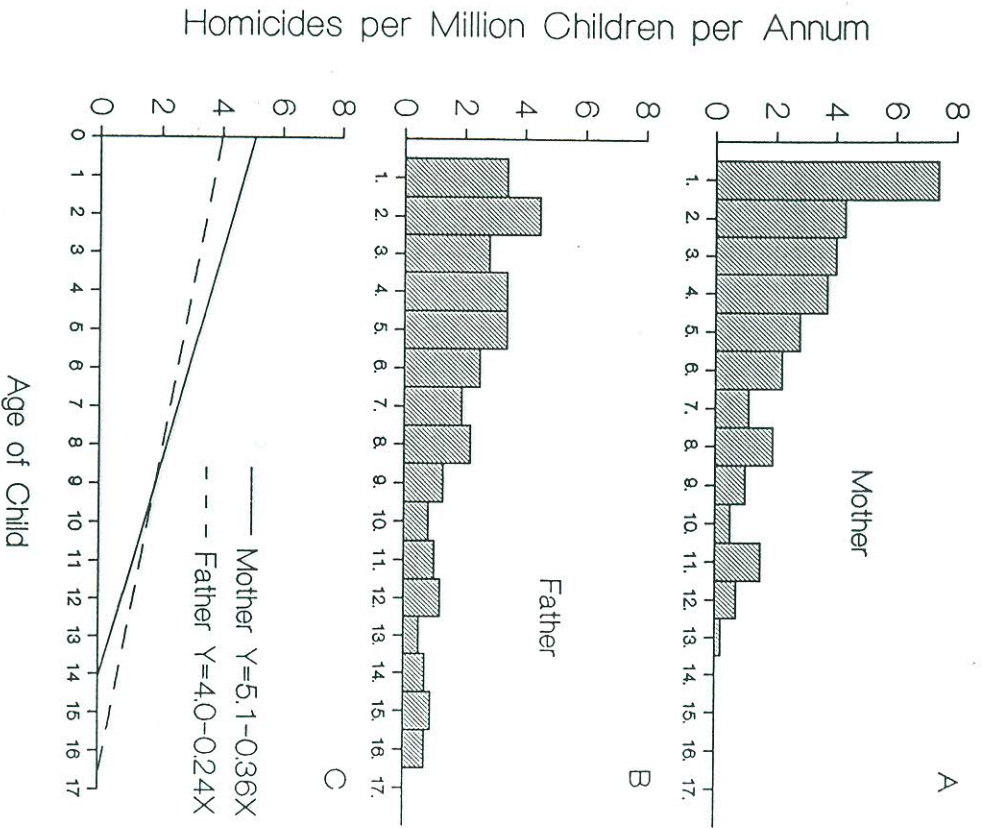


Figure 2 Age-specific rates of homicide victimization among 1-17 year-old Canadian children, 1974-1983: (a) slain by mother (N = 110 victims); (b) slain by father (N = 116); (c) linear regression of homicide rates by mother versus father. Infants < 1 year excluded for linear regression. The slope of the regression of homicide victimization rate on child's age is significantly ($t = 2.3$, $df = 30$, $P < .02$) steeper for mothers than for fathers. (Modified from Daly & Wilson, 1988c).

above as regards infanticides, and is further discussed by Daly and Wilson (this volume). The possibility of varying intensity of paternal solicitude as a function of variation in the putative father's "confidence" (conscious or otherwise) in his paternity is a worthy subject of study. If paternity confidence is sensitive to phenotypic evidence of the child's resemblance to self, for example, one would expect paternal solicitude to vary accordingly. Furthermore, since it is in the mother's interest to promote confidence of paternity, she should be especially motivated to perceive and remark upon paternal similarity, and there is evidence that she is (Daly and Wilson, 1982).

In addition to asymmetries in parent-offspring relatedness, the parental commitment of each parent might be expected to be sensitive to *both* parents' reproductive values. Insofar as a mother, for example, values a child in relation to the expected fitness benefits accruing from her investments, her perception of the father's level of valuation and commitment to the child may be expected to affect her own. The nature of such impacts could vary in direction, since appropriate responses to withdrawal of a partner's investment might be escalated effort on one's own part or giving up altogether or some bet-hedging partial divestment, with the most adaptive course of action depending on many parameters of circumstance, offspring stage and quality, and the parents' alternatives. Lazarus (1990) has considered how selection will shape mated animals' decisions whether to desert and leave the mate to raise the young alone, and has shown that even this binary stay-or-leave issue becomes complex and has non-intuitive equilibria "when strategies are modified in response to the strategy of the partner" (p. 682). The ways in which selection shapes continuous variability in one's level of parental effort relative to one's partner's will be even trickier to analyze, and we need further development of evolutionary models of the parameters and conditions in which there is expected to be variation in each parent's commitment (Winkler, 1987; Montgomerie and Weatherhead, 1988; Knight and Temple, 1988; Weatherhead, 1990).

PARENTAL ATTACHMENT

Parents care profoundly for their children, deriving joy from their welfare and scarcely resenting the prolonged one-way flow of resources. The emotional/motivational/cognitive mechanism that enables such selfless nurture is parental love. Psychologists apparently take parental love so much for granted (in contrast to romantic love, for example) that they have hardly noticed it except in the event of conspicuous lapses therein.

If social psychologists and motivation theorists have largely ignored parental inclinations, however, pediatricians and their applied collaborators have not, and there is a burgeoning literature on parental (mostly maternal) bonding, especially with respect to the effects of postpartum mother-infant contacts. The first wave of empirical studies showed surprisingly powerful and enduring effects of even brief postpartum contact with one's newborn on subsequent maternal responsiveness (Klaus *et al.* 1972; Kennell *et al.* 1974; Sosa *et al.* 1976; de Chateau and Wiberg, 1977a, 1977b; Hales *et al.*, 1977; Carlsson *et al.*, 1978; Kontos, 1978; O'Connor *et al.* 1980; Ali and Lowry, 1981; Grossman *et al.* 1980). Once mothers had been empowered with regard to hospital birthing practices, the focus of subsequent critical scientific discussion turned to (1) criticisms of the unitary causal model of the maternal bonding process; (2) the question of whether a delimited postpartum period was uniquely important; and (3) the relative importance of postpartum contact as compared to other important variables, including paternal support, whether the pregnancy was strongly desired, and the health status of the baby and the mother. Recent discussants (*e.g.* Herbert *et al.* 1982; Egeland, 1982; Lamb and Hwang, 1982; Lamb, 1983; Scheper-Hughes, 1988) often present their analyses as refutations of the "bonding" concept and of the importance of postpartum contact, but the early contact studies have not been invalidated and there is no necessary conflict with demonstrations that situational and other factors also influence maternal feelings (Daly and Wilson, 1987).

The sometimes acrimonious debates about maternal bonding have not been informed by an evolutionary view of parenthood. Thinking about parental psychologies as targets of selection suggests that the development of child-specific parental love is likely to involve at least three distinct processes proceeding over different time courses: an assessment of the quality of the child and the situation, a rapid discriminative attachment to the baby as an individual, and a more gradual deepening of individualized love.

1. Initial "Cues" of Newborn's Fitness Prospects

The first process to be expected is an assessment, in the immediate aftermath of the birth,⁶ of the child and of how its qualities and present

circumstances combine to predict its prospects. If the newborn exhibits deformities or other conspicuous signs of low viability, then the probability of abandoning the infant is raised (see above). There is evidence in the modern West that the birth of a child with major defects commonly evokes an immediate shocked rejection in the parents (*e.g.* Roskies, 1972; Fletcher, 1974; Drotar *et al.*, 1975), a rejection that would undoubtedly lead to quick abandonment in historical settings (*e.g.* Dickeman, 1975; Weir, 1984). Where genetic counselling and termination of pregnancy are available, parents commonly want to abort seriously defective fetuses (*e.g.* Leschot *et al.* 1985).

Beliefs that deformed infants are ghosts or demons (or the progeny thereof) are found sporadically the world round and such beliefs are invoked to justify infanticide. Analogous superstitious allegations about well-formed, healthy babies are essentially non-existent, indicating that "superstition" is not fairly dismissed as ignorant foolishness but functions instead as an ideological buttress to action with a self-interested rationale (Daly and Wilson, 1988a).

Conspicuously defective newborns are rare, of course, but maternal responsiveness in the immediate postpartum also varies with subtle cues of the infant's quality and health (*e.g.* Klaus and Kennell, 1976; Mann, 1992), including being undersized and premature. Very low weight neonates (<1500g) incur increased risk of abandonment or abuse (*e.g.* Hunter *et al.*, 1978; McCormick, 1985) and when such babies are likely to die, parents may distance themselves emotionally and fail to participate in the infant's hospital care (Newman, 1980). Emotional distancing has also been described among impoverished Brazilian mothers of weak, sickly infants expected to die (Scheper-Hughes, 1985). It should be noted that low birthweight in North America is associated with low socioeconomic status, maternal youth, large family size, and close birth spacing (*e.g.* Zuckerman *et al.* 1984), but size and vigor of a newborn may be salient cues modulating the development of parental solicitude. In an observational study of low birth weight twins, the healthier twin was more effective in eliciting maternal responsiveness whereas factors such as duration of postpartum separation and infant smiling did not account for the mother's differential treatment of the twins (Mann, 1992).

Within the first few hours after birth, healthy human infants exhibit a precocious social responsiveness — eye contact and selective attention to maternal speech — that may be a specialized adaptation to advertise quality and elicit maternal commitment during the mother's assessment phase. If circumstances are dicey and the mother is in any way ambivalent, then

⁶Information about the health status of the fetus from ultrasound imaging and other modern medical procedures may activate parental assessment mechanisms at a much earlier stage than the birth; *e.g.* Peppers, 1988.

the poor responsiveness of a baby might tip the scales toward disinclination to raise the child.

In addition to the quality of the newborn, the present situation of the mother and her residual reproductive value should affect bonding. In one experimental study, mothers' responsiveness to their infants on the day of hospital discharge increased with maternal age (Jones, Green and Krauss, 1980); the age effect was not confounded with mother's marital status, socioeconomic status or amount of postpartum contact. (See also Norr, Roberts and Freese, 1989; Abernethy and Yip, 1990.) Some researchers have argued that socioeconomic status, maternal age, and education, rather than the postpartum bonding experience, account for variations in maternal attachment in the various experimental studies (*e.g.* Campbell and Taylor, 1979; Siegel *et al* 1980; Svejda *et al* 1980), but others have argued that these variables enhance the postpartum contact effects (*e.g.* Anisfeld and Lipper, 1983; Norr *et al* 1989).

From a selectionist perspective on the maternal bonding process, it would not be surprising to discover that an experimental procedure of "extra" postpartum contact had little ameliorative effect on mothers when circumstances such as poverty, lack of paternal support and other indices of maternal overburdening "cue" poor fitness prospects. More work is needed to assess whether situational and other variables (such as the mother's residual reproductive value as measured by her age) interact with and modify the effects of particular postpartum experiences.

Many new mothers experience a transient and brief period of the "blues" within the first several days after giving birth (*e.g.* Cutrona, 1982; Hopkins *et al* 1984). A lesser but considerable number experience a more debilitating postpartum depression associated with concerns about their ability to cope with the baby. Such depression is apparently especially likely when the mother is young, when the mother and father are having marital problems, and when mothers are single or otherwise lack social support (*e.g.* Braverman and Roux, 1978; Cox *et al* 1982; Cutrona, 1982; Hopkins *et al*, 1984; Kumar and Robson, 1980), as well as when the infant is suffering from poor health (*e.g.* Blumberg, 1980; Grossman *et al* 1980). These circumstances are very similar to the infanticide circumstances described in the ethnographic literature. Women suffering from extreme postpartum depression are sometimes characterized by clinicians as delusional, but the typical content of the "delusions" seems not at all fantastic: concern about own inability to care for the baby, fear of not having enough love for the baby, and guilt aroused by infanticidal thoughts (*e.g.* Herzog and Detre, 1976).

2. Discriminative Bonding to Own Offspring

Parents are highly sensitive to their babies' distinctive features, recognizing them by voice (Formby, 1967; Morsbach, 1980; Rothgänger, 1981) and by smell (Porter *et al* 1983; Russell *et al* 1983) with only minimal exposure. Some have implied that these abilities represent psychological adaptations for discriminative bonding, but of course, people are very good at recognizing individual faces generally (Diamond and Carey 1986; Damasio *et al* 1990); whether there is a specific heightened postpartum infant recognition ability is still to be determined.

Rather than having merely to recognize her own baby, the "task" confronting the new mother is to develop an individualized commitment to it, such that she is emotionally prepared to invest heavily in its welfare without being at the same time vulnerable to parasitism by children generally. Many new mothers report an initial feeling of "indifference" to their babies (perhaps reflecting the initial "assessment" phase as well as the lack of individuation), but very few feel the same way by one week postpartum (*e.g.* Robson and Kumar, 1980). After having had close contact with their infants over the first few days, mothers commonly report developing a feeling that their baby is uniquely wonderful (*e.g.* Kennell *et al* 1975; Klaus and Kennell, 1976).

Perception of paternal resemblance deserves study as a factor contributing to paternal bonding. Paternity is mistakable, and there is a great deal of evidence that men are much concerned with its accurate assessment. There are at least two obvious sources of information contributing to a putative father's confidence that he is indeed the sire: his confidence of the mother's sexual fidelity and his assessment of the phenotypic similarity of the child to himself and his blood relatives. If assessments of phenotypic resemblance were veridical and disinterested, we would expect equal emphases upon maternal and paternal similarities; however, expressed opinions about who newborn babies resemble are biased toward paternal similarities (Daly and Wilson, 1982). Even among the Trobriand Islanders, famous for their apparent ignorance of the male's role in procreation, it is an offense to remark the infant's similarity to uterine kin and polite to assert resemblance to the father (Malinowski, 1929). Researchers have recently become interested in the effects of men's participation in delivery and other postpartum experiences on paternal bonding, but the issue of paternity has not been discussed in this context. An evolutionary psychological view of paternal bonding suggests that perception of paternal resemblance would be correlated with paternal bonding, and evidence of nonpaternity could wash out any ameliorative effects of participating in the delivery. Furthermore, as we noted with respect to the different age

patterns in filicide (Figure 2), phenotypic cues that alter paternity confidence may not become evident for years, and a certain reserve in paternal bonding may therefore be expected. (Of course, a lesser paternal than maternal involvement in the immediate postpartum may have other sources than the sex difference in parental certainty, most notably in the more essential nurturant role of new mammalian mothers as compared to fathers.)

Paternity disputes provide much evidence of men's disinclinations to support children they claim they did not sire (Wilson, 1987). Two major theories in law have been proposed to justify the imposition of a child support obligation on reluctant putative fathers: the theory of delict, whereby the father's liability arises from illicit sexual access to the mother, and the theory of descent, whereby the father's liability is based on his genetic relationship with the child (Sass, 1977). Descent-based laws are generally perceived as more just and are better complied with—facts with interesting implications about people's implicit understandings of parenthood. The imputation that descent is a just basis for allocating obligation implies that the existence and welfare of children are perceived to constitute *benefits* to their genetic parents, even if the latter are uninvolved and thus failing to derive the usual emotional rewards of parenting. He who sires a child and absconds is deemed a cheater because he has failed to pay the cost to which this received benefit obliges him (c.f. Cosmides and Tooby, 1989). The fact that descent-based systems evoke better compliance than delict-based ones further reflects the fact that men are disinclined to invest in children which are not their own and feel themselves to be victims of injustice when obliged to do so.

3. A Gradual Deepening of Parental Love

The third predictable process of parental attachment is a much more gradual one: The strength of parental love may be expected to grow with the child's increasing RV, especially over the first few years when there is the steepest increase in RV. A recent study of the changes in maternal feelings about the well-being of the infant over the first 16 months after birth supports our expectations about a gradual increase in the valuation of child relative to self (Fleming *et al* 1990); the effect was not merely due to changes in maternal condition or situation as the same measures with respect to self and to husband remained relatively stable over the same period. The authors stated that the postpartum growth in the salience and importance of the infant was "reflected by both an increase in total interview time spent talking about the infant (in both positive and negative terms) and an increasingly large proportion of

women reporting such things as feelings of closeness to their infants, being pleased with their infants' development, or enjoying child-care activities" (p. 141).

The information that parents garner from their continued monitoring of offspring quality should affect the depth and time-course of their love and commitment, especially over the first few years in which infant mortality risk remains high. Since parental effort is a resource to be invested, not squandered, chronic changes in the infants' responsiveness and robustness, consequent upon the effects of malnutrition, dehydration and pathogens, can be expected to dampen parental love, in spite of the infant's greater "need".

In many societies, newborn babies are not immediately named or officially acknowledged by the community, a practice more or less explicitly linked to their uncertain future. Naming bestows personhood and facilitates the individuation of affection. (Indirect evidence for this claim can be found in observations that naming children after relatives is effective in inspiring namesake investment and inheritance; Smith, 1977; Furstenberg and Talvrite, 1980.) The postpartum delay in recognizing infants' personhood corresponds to a period of high mortality risk, perhaps with the effects of facilitating difficult decisions of disinvestment and lessening the emotional pain should the infant die (Mull and Mull, 1988; Schepher-Hughes, 1985). It is something of a cliché to claim that the valuation of children is a recent Western cultural invention, with tales of child brutalization and parental indifference in history and in other societies introduced as support; those making this argument fail to appreciate that seeming callousness is an understandable response to circumstances that make children poor prospects for survival and reproduction, and that the same mothers who seem indifferent to the plight of one child in one context can be profoundly nurturant to others born at other times in more auspicious circumstances (e.g. Pollock, 1983; Bugos and McCarthy, 1984; Vinovskis, 1987).

CONCLUDING REMARKS

Developmental psychologists and pediatricians concerned with variations in parental solicitude have emphasized individual differences and a few experiential factors like postpartum contact and parenting styles experienced in childhood, without coming to grips with the task of producing a general theory of parental motivation (Daly and Wilson, 1987, 1988a,b). We attribute this piecemeal approach to the practitioners' lack of a theoretical

framework that would enable them to make sense of variable parental inclinations. Darwinism provides that framework.

Evolutionary theory is not a substitute for psychological analysis, but a valuable aid thereto: Understanding how selection operates and what behavioral control mechanisms have been designed to achieve affords innumerable hints to their probable organization. Improved maternal efficacy over the lifespan, to take one example, has routinely been assumed to reflect the acquisition of skills and/or knowledge, and the "immaturity" of young mothers. The theory and facts reviewed in this chapter suggest that such lifespan changes may often reflect adaptive changes in maternal inclinations as maternal RV and opportunities change, rather than the mere alleviation of incompetence with experience (Taylor, Wadsworth and Butler, 1983; McCormick, Shapiro and Starfield, 1981; Abernethy and Yip, 1990). This alternative view suggests many possible lines of research.

Although evolutionary reasoning is no alternative to psychological accounts of parenting, it does provide grounds for suspecting that certain prevalent conceptions of parenthood and family relations misrepresent their essences. The popular focus on families as "systems" and their members as components thereof cannot be correct, for example, insofar as it ignores the fact that family members are agents with only partially congruent interests and elevates the "system's" objectives above those of its actors. A quarter century of criticism of naive group selectionism in biology has clarified why individual organisms are the appropriate level in the hierarchy of life at which to impute integrated agendas, and why the analogizing of larger groups to self-interested individuals typically fails (e.g. Williams, 1971; Dawkins, 1982). Similarly, the prevalent treatment of parenthood as a "role" is not adequate to capture its crucial features (Wilson and Daly, 1987; Daly and Wilson, this volume); again, the problem is one of weak analogy because of a failure to articulate selectively significant aspects of the phenomenon under consideration.

A crucial contribution of evolutionary reasoning to the study of parent-offspring relations will come from the diffusion and further development of the analysis of the individual actors' conflicting agendas, as pioneered by Trivers (1974). "Socialization" cannot be simply the tutelage of children to function in society, as it is so often portrayed, for although children are the fitness vehicles of parents who have evolved to cherish and nurture them, their interests are not identical. Evolved ontogenies must be complex in order to accept information from partly beneficent tutors while resisting manipulations which would make the young pursue others' interests rather than their own. (Contemporary psychology's gerontocentric preoccupation with the "socializing" function of parenting reflects

a contemporary circumstance of relative affluence, almost forgetting the fundamental nourishing and protective functions of parental inclinations and repertoires.) Evolved parental psychologies must be equally subtle in the face of self-interested offspring.

Parental motives, emotions, and contingent decision rules have a complex functional interrelatedness that is unlikely to be elucidated without recourse to Darwinism.

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