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The Functions of Postpartum Depression

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Evolutionary approaches to parental care suggest that parents will not automatically invest in all offspring, and they should reduce or eliminate investment in their children if the costs outweigh the benefits. Lack of paternal or social support will increase the costs born by mothers, whereas infant health problems will reduce the evolutionary benefits to be gained. Numerous studies support the correlation between postpartum depression (PPD) and lack of social support or indicators of possible infant health and development problems. PPD may be an adaptation that informs mothers that they are suffering or have suffered a fitness cost, which motivates them to reduce or eliminate investment in offspring under certain circumstances, and that may help them negotiate greater levels of investment from others. PPD also appears to be a good model for depression in general.

KEY WORDS: Postpartum depression; Parental investment; Life history theory; Evolutionary psychology; Reproduction; Mental health.

Mothers with postpartum depression (PPD) commonly have thoughts of harming their children, exhibit fewer positive emotions and more negative emotions toward them, are less responsive and less sensitive to infant cues, less emotionally available, have a less successful maternal role attainment, and have infants that are less securely attached (Beck 1995, 1996b; Cohn et al. 1990, 1991; Field et al. 1985; Fowles 1996; Hoffman and Drotar 1991; Jennings et al. in press; Murray 1991; Murray and Cooper 1996). Although most researchers view PPD as a disorder, evolutionary theorists frequently have argued that there are circumstances when it would be in the mother's fitness interest to reduce or eliminate her investment in her offspring, for example, when there

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is insufficient social support to raise the infant, or when the infant has low viability (Clutton-Brock 1991; Daly and Wilson 1984, 1988; Hrdy 1979, 1992; Trivers 1974).

PPD is a depressive episode with onset occurring one month postpartum (APA 1994).[1] Depressive episodes are characterized by a number of symptoms including depressed or sad mood, marked loss of interest in virtually all activities, significant weight loss or gain, insomnia or hypersomnia, psychomotor agitation or retardation, fatigue or loss of energy, feelings of worthlessness or guilt, diminished ability to think or concentrate, and recurrent thoughts of death (APA 1994). A diagnosis of a DSM IV major depressive episode requires that five of these symptoms be present during a two-week period, and that at least one of the symptoms is either depressed or sad mood, or a markedly diminished interest or pleasure in all or almost all activities.

Three correlates of PPD are consistently found by researchers: marriage problems and lack of social support, particularly the father's (Table 1), infant problems, including pregnancy and delivery problems (Table 2), and a prior history of depression or other emotional problems (Atkinson and Rickel 1984; Cutrona and Troutman 1986; Gotlib et al. 1991; Graff et al. 1991; Logsdon et al. 1994; O'Hara et al. 1983, 1984; Whiffen 1988; Whiffen and Gotlib, 1993). This paper will propose three related adaptive functions for PPD that are consistent with the expectations of evolutionary theorists and the first two correlates noted above. First, negative affect—i.e., sad or depressed mood—should be associated with social circumstances that were reproductively costly in ancestral environments (e.g., lack of social support or infant problems). This "psychological pain" hypothesis (Alexander 1986; Nesse 1991; Nesse and Williams 1995; Thornhill and Thornhill 1989, 1990; Tooby and Cosmides 1990) is strongly supported by existing evidence. Second, mothers will take actions to reduce their levels of psychological pain, thereby reducing their reproductive costs. This hypothesis is also well supported by existing evidence.

The third hypothesis applies to major rather than minor PPD. A minor form of PPD involving fewer and less severe symptoms is sometimes distinguished from PPD involving a major depressive episode.[2] Minor PPD is consistent with the psychological pain hypothesis and the two proposed functions described earlier. Symptoms of major PPD not well accounted for by the psychological pain hypothesis—e.g., marked loss of interest in virtually all activities, psychomotor retardation, significant weight loss, diminished ability to think or concentrate, and recurrent thoughts of death—may enable the mother to negotiate greater levels of social support, the third functional hypothesis. In the same way that a valuable employee may attempt to negotiate a larger salary by threatening to quit, mothers receiving insufficient so-

[1]The one-month criterion established by the American Psychiatric Association is obviously somewhat arbitary and is meant to distinguish PPD from the far more common, less severe, and transitory blues experienced by two thirds of all mothers in the first 1–2 weeks postpartum. The relationship between PPD and the blues in not clear. PPD is also distinguished from postpartum psychosis, a rare and extreme set of symptoms involving delusions and hallucinations.

[2]Virtually all studies of PPD rely on either clinical diagnosis according to the criteria in the Diagnostic and Statistical Manual (DSM), International Classification of Diseases (ICD), or on depression instrument scores (e.g., Edinburgh Postnatal Depression Scale, Cox et al. 1987) representing a continuum of severity. Minor PPD is usually not diagnosed separately, but is defined by establishing a lower cutoff for a self-report score, or for number of symptoms reported.

cial support may attempt to negotiate larger levels of support by threatening to defect from (i.e., quit) the childrearing endeavor. This hypothesis cannot be adequately tested with the data that are currently available and it is justified on purely theoretical grounds; as such, it is quite speculative.

Because each of these hypotheses involves either an aspect of a mother's decision to invest in or defect from childrearing, or her attempt to negotiate larger levels of support by threatening to defect from childrearing, I will refer to them collectively as the defection hypothesis for PPD. The defection hypothesis, its theoretical foundations, and supporting data will be presented in detail in the following sections. These data are not sufficient to *prove* the defection hypothesis, however. Other interpretations of the data are possible, and I consider it well beyond the scope of the paper to analyze these other interpretations (there is no consensus on the correct theoretical approach to PPD; see Affonso (1984), Cutrona (1982), and Hopkins (1984) for brief reviews of psychodynamic, personality, cognitive-behavioral, and biophysical theories of PPD. See Cramer (1993), Collins et al. (1993), Cutrona (1983), Cutrona and Troutman (1986), Gotlib et al. (1991), O'Hara et al. (1982), and O'Hara et al. (1984) for experimental tests of particular theories of PPD).

THEORETICAL FOUNDATIONS

Parental Investment Theory

The close association of PPD with child bearing and rearing suggests that the application of parental investment (PI) theory may be quite fruitful (see, e.g., Clutton-Brock 1991). PI theory, an aspect of life-history theory, provides the evolutionary framework for nearly 20 years of research into parental investment in offspring for both humans (Betzig et al. 1988; Blurton-Jones 1989; Borgerhoff Mulder 1989; Chisholm 1993; Daly and Wilson 1984, 1988; Dickemann 1979, 1981; Draper and Harpending 1982; Hagen 1996, 1998c; Haig 1993; Hartung 1982, 1985; Hill and Kaplan 1988; Hrdy 1992; Lampert and Friedman 1992; Voland 1984) and other species (the literature is huge; for recent syntheses see Clutton-Brock 1991; Roff 1992; and Stearns 1992).

Both PI theory and life-history theory (of which PI theory is a part) form the basis of this functional analysis of PPD. To briefly review, life-history theory posits that in order to have left descendants, the ancestors of any species must have solved the problems of survival, growth, development on the one hand, and reproduction on the other. Because each of these problems is characterized by unique difficulties, and because time, energy, and resources are finite, organisms must optimally allocate these commodities between *somatic effort* (growth, development, and maintenance of the organism), and *reproductive effort* (producing offspring who themselves survive to reproductive age).

Reproductive effort, in turn, should be optimally allocated between *mating effort* (locating and acquiring a mate), and *parenting effort* (e.g., gestation and raising of offspring)—what I have here termed parental investment in order to be consistent with existing literature (see Clutton-Brock 1991, p. 8, for a discussion of terminol-

Table 1. Studies that Found a Correlation between Social Support and Marriage Variables and Postpartum Depression

Study	Correlate of PPD
Emotional support	
Affonso and Arizmendi 1986	Inadequate emotional support
Campbell et al. 1992	Inadequate emotional support*
O'Hara 1983	Less emotional support from confidants*
O'Hara 1983	Less emotional support from mom*
O'Hara 1983	Less emotional support*
O'Hara 1986	Inadequate emotional support*
Richman et al. 1991	Inadequate emotional support
Richman et al. 1991	Inadequate intimacy
Richman et al. 1991	Inadequate reassurance
Instrumental support	
Campbell et al. 1992	Less help from husband at 2 months*
Collins et al. 1993	Less material support received
Collins et al. 1993	Less satisfaction with material support
O'Hara 1983	Less instrumental support*
O'Hara 1986	Less instrumental support*
Paykel et al. 1980	Less help from husband
Richman et al. 1991	Less practical support
Spousal support	
Richman et al. 1991	Low spouse support
Spangenberg and Pieters 1991	Dissatisfaction with marital support
Communication	
O'Hara 1983	Less communication*
Paykel et al. 1980	Poor communication with husband
Nonspousal support	
Cutrona and Troutman 1986	Low social support
Kumar and Robson 1984	Current problems in relationship with mom*
O'Hara 1983	Confidants less available*
Richman et al. 1991	Lack of father support
Richman et al. 1991	Lack of mother support
Richman et al. 1991	Other
Spangenberg and Pieters 1991	Dissatisfaction with social support
Miscellaneous support	
Richman et al. 1991	Low overall support
Trotter et al. 1992	Lack of "doula" (supporting female) at birth
Marriage	
Affonso and Arizmendi 1986	Poor relationship with baby's father
Dimitrovsky et al. 1987	Poor marital relation
Gotlib et al. 1991	Poor dyadic adjustment*
Kumar and Robson 1984	Marital conflict*
Logsdon et al. 1994	Poor postpartum closeness to husband
McGill et al. 1995	Bad relationship PPD = 31%, not depressed = 4.5%
O'Hara 1983	Marital problems*
Whiffen 1988	Poor prepartum marital adjustment/mood

* Postpartum depression (PPD) assessed by clinical diagnosis; otherwise by self-report.

ogy). PI theory focuses on those aspects of an organism's life-history that are specifically involved with producing and raising offspring.

Life history theorists assume that the physiological and behavioral characteristics of organisms represent an approximate solution to the problem of optimizing the allocation of time, energy, and resources between somatic, mating, and parenting effort, with the particular solution depending on the organism's environmental niche

Table 2. Studies that Found a Correlation between Infant Quality Variables and Postpartum Depression

Study	Correlate of PPD
Prenatal and delivery problems	
Campbell and Cohn 1991	Pregnancy and delivery complications*
Campbell et al. 1992	Minor pregnancy and delivery complications (e.g., elevated blood pressure, gestational diabetes, prolonged labor)*
O'Hara 1984	Obstetric risk factors (abnormal weight gain during pregnancy, abnormal uterine size, preeclampsia, significant bleeding, abnormal presentation, fever in labor, and the presence of meconium-stained amniotic fluid) accounted for 19% of the variance in depressive symptomology
Paykel et al. 1980	Subjective stress of pregnancy; Objective rating of labor complications
Postnatal problems	
Atkinson and Rickel 1984	PPD in men predicted by perception that infant was below average
Hopkins et al. 1987	Infant complications accounted for 12% of variability in depression scores*
Kumar and Robson 1984	Premature baby*
Whiffen and Gotlib 1989	Mental development at 2 months; infants more tense, less happy, and have lower endurance at 2 months*
Unexpected correlations	
O'Hara et al. 1982	PPD associated with less complicated deliveries
Paykel et al. 1980	PPD associated with less complicated deliveries
No correlation	
Warner et al. 1996	PPD not associated with complicated pregnancy (sampling of women was not random with respect to pregnancy problems, which may have affected the results)

* Postpartum depression assessed by clinical diagnosis; otherwise by self-report.

as well as its evolutionary history. In general, effort allocated to reproduction will decrease an organism's ability to survive, grow, and develop, whereas, conversely, effort allocated to survival, growth, and development will decrease reproduction. Similarly, effort allocated to finding a mate will decrease an organism's ability to invest in offspring, whereas effort invested in offspring will reduce an organism's ability to acquire a mate. If parental investment can only occur at the expense of somatic or mating effort, then parents need to decide, based on current circumstances, whether it is more advantageous to invest finite resources in offspring, mates, or themselves. Investment in new offspring should not be automatic.

A number of straightforward predictions follow from PI theory, two of which will be the focus of this paper. First, when offspring require significant investment from mothers, mothers should assess offspring viability (e.g., health) before providing the investment. Second, when offspring require significant investment from both fathers and mothers in order to survive to reproductive age, mothers should assess the availability of father investment before investing themselves.

There is a correspondence between these two predictions of PI theory, and two widely replicated correlates of postpartum depression, namely the mother's perception of lack of support from the father, and "infant problems," including pregnancy and delivery problems (Tables 1 and 2). While PI theory makes it clear why a mother who has an infant with problems or who is receiving insufficient social sup-

port will neglect, abandon, or kill her offspring, it does not make clear why these circumstances lead a mother to experience depression. The answer may lie in the link between adaptive problems and consequent adaptive behavior, that is, it may lie in the evolved psychology of the mother.

Evolutionary Psychology

The functional properties of organisms are called *adaptations*, and the terms function and adaptation will be used interchangeably in this paper. Briefly, adaptations evolved because they solved the recurring problems of survival and reproduction discussed in the previous section. Hearts, lungs, and eyes are typical examples of adaptations, and each evolved to solve an important problem: hearts circulate nutrients to other tissues in the body, lungs extract oxygen from the atmosphere, and eyes collect visual information from the environment. These organs are recognized as adaptations because the features of each correspond closely to the problems they were intended to solve. This correspondence is called evidence of design. The chambers and dense muscles of the heart are ideally designed for pumping blood, but poorly designed for absorbing large quantities of gaseous oxygen. The numerous cavities of delicate tissue that comprise the lungs are ideally designed for absorbing oxygen, but completely ineffectual for focusing light. In order to solve the many problems involved in reproduction, many adaptations are needed. Any organism can therefore be viewed as a large but finite set of functional components, or adaptations, each of which was designed by natural selection to solve a particular reproductive problem in ancestral environments.

The brain, like the rest of the body, consists of a number of adaptations, with vision, hearing, smell, motor control, and physical pain being obvious examples. Evolutionary psychology is the subfield of evolutionary biology that is attempting to identify the functional components of the brain, often referred to as psychological adaptations (Barkow et al. 1992; Daly and Wilson 1983, 1984; Symons 1979). Like other adaptations, a psychological adaptation can be recognized by evidence of its having been designed by natural selection to solve a particular reproductive problem. For example, physical pain functions to inform an animal that its tissue is being damaged, provides information on the precise location of the damage, motivates the animal to withdraw from the damage-causing circumstances, and conditions the animal to avoid similar circumstances in the future. Each of these capabilities requires a sophisticated organization of the nervous system, and each would have facilitated reproduction of the organism.

In general, psychological adaptations evolved to extract information from the environment that was relevant to reproductive problems, and to then generate behaviors, that, on average, solved these problems. It will be argued here that PPD shows evidence of having been designed by natural selection to solve three important problems of the puerperium, and is therefore not an illness, but an adaptation.

The suggestion that PPD is a functional component of human reproductive decision-making was first made by Daly and Wilson (1988), and Wilson and Daly (1994), who have published extensively on parental cognition in evolutionary per-

spective (e.g., Daly and Wilson 1980, 1987, 1995). In particular, Wilson and Daly (1994) pointed out that both lack of social support and infant problems were associated with PPD, and that, in accord with evolutionary expectations, PPD disinclined mothers to invest in their offspring. This functional hypothesis for PPD has been further elaborated by Hagen (1996, 1998a, 1998b), and Thornhill and Furlow (1998), and will be explored in detail here.

Before proceeding, it is important to point out that adaptations can operate even though individuals may have no conscious awareness of their function. None of our ancestors had any awareness or understanding of the function of fever, for example. In an attempt to avoid lengthy and awkward sentences, however, I use the words "decide" and "should" to indicate the operation of an adaptation, with no conscious or moral intent implied. For example, the phrase "mothers decide to defect from their infants when . . . " is shorthand for "a maternal psychological adaptation to defect from the infant is activated when . . .." Similarly, the phrase "mother *should* defect from their infants when . . ." is intended to be shorthand for "mothers who defected from their infants when . . ., would have had, on average, a greater number of descendants than those who did not defect."

THE DEFECTION HYPOTHESIS FOR PPD, PART ONE: ASSOCIATION OF NEGATIVE AFFECT WITH CORRELATES OF NET FITNESS COSTS

This section will specify in greater detail some of the adaptive problems faced by ancestral human mothers, and it will propose one deceptively simple but very important psychological function that would have been necessary to address these problems, namely, that ancestral mothers needed to know when their costs were exceeding their benefits. PPD may, in part, assist the mother in determining whether she is suffering (or has suffered) circumstances that were associated with net fitness costs over evolutionary time. The other two components of the defection hypothesis, that PPD may function to reduce investment by the mother or increase the investment of others, will be discussed in later sections.

Costs of the Puerperium

The major benefit of bearing an offspring—a reproductively successful child—involves a substantial investment from the mother. The time, energy, and resources required to successfully rear human infants are enormous, a consequence of the considerable degree of brain growth and development that occurs postpartum (Lancaster 1986). Human offspring are unable to fend for themselves; they require mothers to provide several years of direct care. In addition to direct care, mothers in preindustrial populations provide all the fuel for brain development. Breast feeding is metabolically expensive, and the energetic costs of lactation are actually greater than the energetic costs of pregnancy (Worthington-Roberts et al. 1985). The 36,000 kcal of fat that a female may have stored under ideal conditions is sufficient to pro-

Table 3. Poor Neonatal Outcome is Associated with "Minor" Pregnancy and Delivery Problems that are strongly Associated with Postpartum Depression*

Study	Outcome
Acien 1996	The perinatal mortality rates in breech presentations were more than twice those of the total number of deliveries in Latin America, and more than three times the total number in Spain and Portugal.
Ananth et al. 1995	Hypertensive disorders were found to have a strong adverse impact on stillbirth rates (North Carolina).
Beischer et al. 1996	Gestational diabetes was associated with a significantly higher rate of perinatal mortality, especially if untreated (Australia).
de Courcy-Wheeler et al. 1995	Small size for gestational age (itself a strong predictor of perinatal mortality) was significantly associated with proteinuric hypertension (Britain).
Gupta et al. 1996	Twenty percent of babies born through meconium-stained amniotic fluid (MSAF) suffered severe birth anoxia (lack of oxygen) compared to 5.6% in the non-MSAF group (India).
Hawthorne et al. 1994	The perinatal mortality (PNM) in women with gestational glucose intolerance was 49.2 of 1,000 compared to a PNM in the background population of 11.6 of 1,000. The fetal malformation rate was 17.3% for established diabetes, 9.8% in gestational glucose intolerance, and 2.2% in the background population (Britain).
Omu et al. 1996	Despite the economic expenditure of about five times more for hypertensive women in pregnancy than in controls, both obstetric and neonatal outcome are still significantly worse in the former (Kuwait).
Schieber et al. 1994	Prematurity, malpresentation, and prolonged labor accounted for significant proportions of the observed perineonatal mortality (rural Guatemala).
Scorza 1996	Breech presentation is associated with significantly increased risk of perinatal morbidity and mortality. Most of the morbidity and mortality associated with breech delivery results from cord compression, entrapment of an arm behind the head (nuchal arm), and difficulty in the delivery of the aftercoming head.
Walker 1996	Pregnancy-induced hypertension remains the largest cause of maternal death in the United Kingdom.
Weiss et al. 1994	In unrecognized and hence untreated pregnancies involving gestational diabetes, perinatal morbidity and mortality are increased 20-fold (Germany).

*See Table 2 and text for details.

vide only about one third of the energy required to support 4 to 5 months of lactation (Widdowson 1976). The typical woman in a preindustrial setting is unlikely to conform to this western ideal, however. She often begins pregnancy with lower nutritional reserves, gains little if any fat during pregnancy, may lactate for more than 3 years, may be subject to special dietary restrictions during lactation, and must provide virtually all of the infant's nutrition for at least the first 6 months postpartum (Wood 1994). Lactation will occur at the expense of maternal stores, and the net effect of these differences is that the nutritional status of women in traditional societies often declines sharply over the course of lactation, a phenomenon referred to as maternal depletion syndrome (Bongaarts and Delgado 1979; Miller and Huss-Ashmore 1989). Nursing an infant can seriously impact the mother's health.

The postpartum period is clearly a very expensive one for the nursing mother, much more so than pregnancy. The decision to invest in the infant is consequently of critical importance, and a necessary functional component of the mother's decision-making process is information on whether her costs are exceeding her benefits.

Many researchers have attempted to identify functions for psychological dis-

tress, neuroses, and depression that would compensate for their obvious costs (Alexander 1986; Birtchnell 1993; Gardner 1982; Gilbert 1989; Henderson 1974, 1981; McGuire and Troisi 1998; Nesse 1991; Nesse and Williams 1995; Price et al. 1994; Slavin and Kriegman 1992; Thornhill and Thornhill 1989, 1990; Watson and Andrews, unpublished; Wenegrat 1995). Virtually all propose functions involving an adaptive response to varied interpersonal problems. In particular, several of these researchers have proposed that whereas physical pain functions to inform individuals that they have suffered a bodily injury, psychological pain informs individuals that they have suffered a nonbodily injury (sometimes referred to as a "social injury") motivating them to cease activities that would further this injury, as well as to avoid any future situations that also would result in injury (Alexander 1986; Nesse 1991; Nesse and Williams 1995; Thornhill and Thornhill 1989, 1990; Tooby and Cosmides 1990). A nonbodily injury is any circumstance, usually involving relationships with others, that was reliably associated with a reduction in reproductive fitness over evolutionary time, e.g., the death of children and relatives or loss of status.

An important symptom of PPD is a sad or depressed mood (APA 1994). The first and most strongly supported functional hypothesis for PPD offered here is that a sad or depressed mood is information to the mother that she is suffering (or has recently suffered) circumstances that were reliably associated with net reproductive fitness costs over evolutionary time.

Failure to Offset Puerperal Costs: Hypothesized Etiological Factors for PPD

If PPD functions, in part, to inform mothers that they are suffering or have suffered circumstances that were reliably associated with net reproductive fitness costs, then these circumstances should be important etiological factors for PPD. New mothers have just invested 9 months in the new offspring, and they need to evaluate their decision to get pregnant, decisions made during pregnancy, and whether to continue to invest in the offspring in light of the following circumstances that would have either substantially increased their costs or reduced their benefits (for a similar list see Mann 1992):

1. There is insufficient investment from the father or others to successfully raise the offspring.
2. There are problems with pregnancy, birth, or with the infant that indicate that this offspring may have low viability, that is, is unlikely to survive to reproductive age.
3. Environmental conditions are poor for raising an offspring (e.g., harsh winter, insufficient resources).
4. There are large opportunity costs—investment in the offspring precludes investment in other beneficial activities. In this case, investment directed toward the offspring would be more profitably directed toward:

   A. Existing offspring
   B. The mother's own survival, growth, and development, and thus her ability to invest in future offspring
   C. Finding a better mate.

During our evolutionary history, investment by others was key to reducing the costs of childrearing and increasing infant viability. Lack of social support, even in populations with access to modern health care, correlated in one study with lower birth weight babies, lower scores on the 5-minute Apgar test (which rates respiratory effect, muscle tone, heart rate, reflex irritability, and skin color 5 minutes after delivery), and labor difficulties (Collins et al. 1993).

Numerous developmental problems can significantly reduce infant viability. Poor neonatal functioning should be associated with negative affect. In addition to obvious infant problems, reliable *predictors* of infant problems, particularly those predictors that occur prepartum, would be very useful to ancestral mothers attempting to evaluate offspring viability. Pregnancy and delivery problems like gestational diabetes, pregnancy-induced hypertension, and abnormal presentation are significant predictors of high child malformation and mortality rates even when mothers have access to modern medical care (see Table 3; also see footnote 3 for possible confounding factors).

Considering that ancestral mothers did not have access to modern medical technology, pregnancy and delivery problems would have been excellent predictors of lowered infant viability, even in the absence of overt infant defects. Mothers with pregnancy or delivery problems therefore should be more likely to consider defecting from the childrearing venture than those without such problems. If infants have health problems that would have been reliably reversible in ancestral environments, e.g., moderately low birth weight or mild infections, and the resources to deal with such problems, they should increase rather than decrease their investment in the offspring (see Mann 1992 for a discussion of circumstances that should lead to an increase in maternal investment in the infant).

Even when mothers have healthy, happy babies and plenty of social support, there may not be enough resources to successfully raise them. Assuming adequate fat reserves, lactation still requires an additional 500 kcal/day (Worthington-Roberts et al. 1985). If food is scarce, mothers may not be able to safely provide this resource to new offspring without jeopardizing their own health or the health of existing children.

Finally, it is possible that higher quality long-term mates are available, even if the mother's current mate is willing and able to invest. Potential mates may be healthier or have access to significantly greater resources than the current mate, for example. Logically, "mate quality" is distinct from "investment." However, a father's "mate quality" includes his ability and willingness to invest in the mother and offspring. Because I am aware of no studies that correlate PPD with the availability of potential mates that are healthier or have greater resources, mate quality will, for the purposes of this article, be considered synonymous with ability and willingness to invest. Prediction 4c about the mother trading-off in the new offspring investment against finding a better mate then reduces to prediction 1 about insufficient paternal investment.

Given that each of these factors should significantly impact mothers' decisions to invest in their infants, they should obviously also be significant etiological factors for affective states that inform those decisions—each of these factors should predict

PPD. As will be discussed, the evidence that factors 1 and 2 predict PPD is excellent; the evidence that factors 3 and 4 predict PPD is currently limited.

Prevalence of Postpartum Depression versus Nonpostpartum Depression: A Caveat

The defection hypothesis requires that pregnancy and childbirth are causal factors for PPD. Given that the base rates for depression and depressive symptoms are high among women in community samples, it is not clear that depressions occurring postpartum are anything other than coincidentally related to pregnancy and childbirth, an important issue that is surprisingly understudied.

Whiffen (1992) found the overall rate for PPD of 13.0% to be approximately double the community rate for nonpostpartum major and minor depression. The comparison of these rates did not control for marital status. The 1-year prevalence rates of major depression in community samples among married women is much lower (2.1%) than among divorced women (6.3%) (Weissman et al. 1991). Because most postpartum women are married, controlling for marital status would likely increase the difference between the baseline rate and the rate postpartum, increasing the probability that PPD is causally related to childbirth.

The best controlled study of prevalence rates (Cox et al. 1993) found no significant differences between postpartum depressed women and women in a control group in either point prevalence at 6 months postpartum or 6-month prevalence rates (see also Campbell and Cohn 1991; O'Hara et al. 1990), but did find that the rate of onset was three times higher for the postnatal group versus the control group within 5 weeks of childbirth. Therefore, the available evidence supports the conclusion that at least some cases of depression postpartum are nonrandomly associated with parturition, although this issue clearly warrants further study.

Tests of the Defection Hypothesis for Postpartum Depression

Prediction 1: lack of social support should predict negative affect. Lack of "support" from the spouse, family, and others is strongly correlated with PPD, a result that has been replicated in numerous studies. The correlation of lack of spousal support with PPD is virtually undisputed (see Table 1) and holds regardless of whether PPD is assessed by symptom levels from self-report instruments or clinical diagnosis (correlations with clinical diagnoses of PPD are marked with an asterisk in Table 1). The association of PPD with lack of social support is also supported by two meta-analyses (Beck 1996c; O'Hara and Swain 1996).

A causal relationship between marital satisfaction and PPD in women is supported by the study of O'Hara (1985) of depressive symptomology and marital satisfaction in 51 couples. In this study, 18.0% of the women and 7.8% of the men had symptoms of at least mild depression at 6 weeks postpartum. The depression and marital satisfaction scores obtained from the husbands at 6 weeks were excellent predictors of their wives' depression and marital satisfaction scores obtained 3

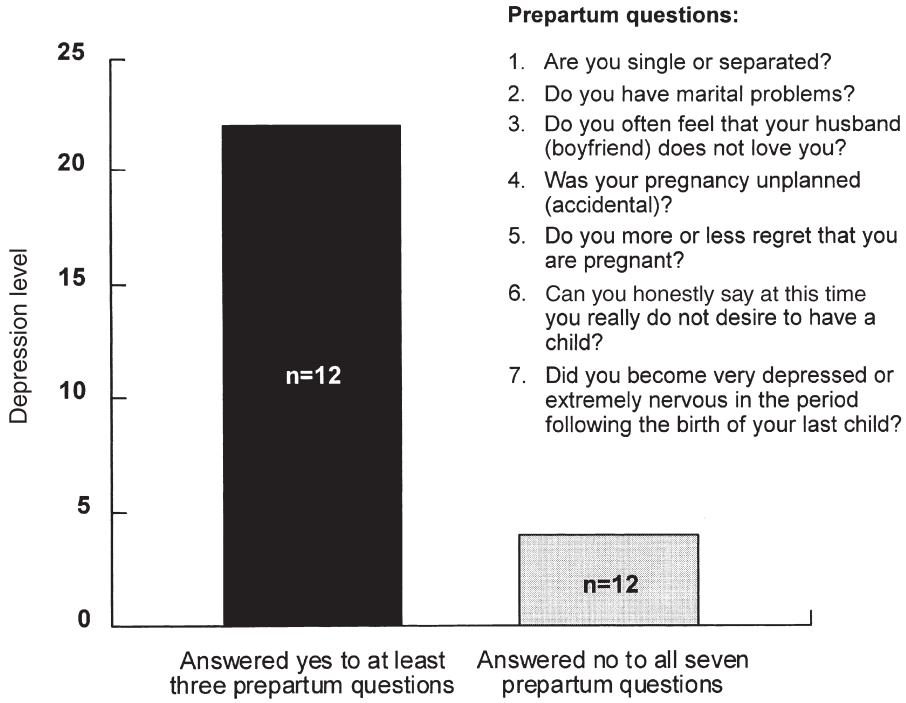

FIGURE 1. Prepartum factors that predict postpartum depression (data from Field et al. 1985).

weeks later. If the father's scores are an indication of his ability or willingness to invest in childrearing (as is true for mothers; see part II), then these data support a causal relation between paternal support and maternal PPD.

The etiological significance of marital satisfaction is also supported by the prospective study by Gotlib et al. (1991) of PPD among a sample of 730 pregnant women. Women who were not depressed during pregnancy but became depressed postpartum were distinguished from those that did not become depressed postpartum by lower marital satisfaction during pregnancy. It should be emphasized that the difference in marital satisfaction scores was obtained before the onset of depression, when all women in the subsample were not depressed—marital discord preceded the onset of depression. This study also assessed factors involved in the postpartum recovery from depression experienced during pregnancy. Of the women who were depressed during pregnancy, those who recovered postpartum reported significantly greater postpartum marital satisfaction. Similarly, Campbell et al. (1992) found high levels of help from spouses and better interactions with infants to be the only variables associated with remission of PPD.

The study of Field et al. (1985), where a simple questionnaire was administered to a large number of women in the third trimester (Figure 1), also supports a causal relationship between paternal investment and PPD. Questions 1 to 3 address the

availability and reliability of paternal investment, whereas questions 4 to 6 address the value of the pregnancy to the mother. These are precisely the factors that should most strongly predict a negative affective response to the childrearing endeavor, and in fact they do.

Although a prior history of depression, question 7, is a strong predictor of PPD, this factor is neutral with respect to the defection hypothesis. Many theories of depression, including this one, are consistent with past vulnerability predicting future vulnerability. This predictor therefore will not be addressed in this article.

In summary, women without social support, particularly the father's support, are at significantly increased risk for PPD.

Prediction 2: Low infant viability should predict negative affect. Problems with the baby decrease the mother's fitness benefits (on average) and, therefore, should increase the odds that she will experience negative affect postpartum. As noted earlier, pregnancy and delivery problems are significant predictors of child morbidity and mortality and, therefore, should predict negative affect postpartum. Consistent with these predictions, a number of studies show strong correlations in the expected direction between pregnancy, delivery, and infant problem variables and PPD (Table 2).[3] As with social support, these correlations do not appear to depend strongly on making a distinction between depressive symptomology and clinical diagnosis. Unfortunately, pregnancy, delivery, and infant complications are presented as aggregate scores, so the correlation of any particular problem with PPD cannot be determined from the literature.

In the study by Hopkins et al. (1987), infants of depressed mothers had experienced significantly greater incidence of neonatal complications than infants of nondepressed mothers (32% vs. 4%). O'Hara et al. (1984) found that although a general measure of life events was not a significant predictor of PPD, childcare-related stressors (e.g., baby health problems) and obstetric risk factors accounted for 19% of the variance in depressive symptomology.

In the study by Campbell and Cohn (1991) of more than 1,000 primiparous middle class mothers of *healthy* full-term infants, the depressed group reported significantly more complications during pregnancy or delivery than the nondepressed group. A high correlation between pregnancy and delivery problems, and depression

[3]Haig (1993) argues that gestational diabetes and pregnancy-induced hyptertension, two important types of pregnancy problems, are fetal strategies to extract additional resources from the mother when circumstances indicate that the father is less likely to invest. If so, their association with PPD may be through the shared variable of social support rather than their association with higher rates of perinatal morbidity and mortality and, therefore, cannot be construed as evidence in favor of the defection hypothesis. An alternate hypothesis is that the fetus may attempt to extract additional resources from the mother to increase its odds of survival when it has information that it is damaged in some way (still assuming a conflict between maternal and paternal genes, of course). This hypothesis would account for the association between gestational diabetes and hypertension, and higher rates of infant morbidity and mortality. Under this scenario, the morbidity and mortality data for these disorders support the defection hypothesis.

In addition to being a significant predictor of child morbidity and mortality, pregnancy-induced hypertension is a leading cause of maternal death (Grimes 1994; Li et al. 1996; Ni and Rossignol 1994; Walker 1996). The apparent association of pregnancy-induced hypertension with PPD therefore may also be evidence in favor of prediction 4: it may be in the mother's interest to invest in her own survival and development rather than the infant. This prediction will not be tested further due to lack of data.

in mothers of apparently *healthy* infants 1 month or more later is strong evidence for the defection hypothesis. When studies that include only mothers of healthy infants show strong correlations between pregnancy problems and PPD, it implies that this relationship may be due to the existence of a neurophysiological link between these indicators of lowered infant viability and PPD that is independent of the mother's subjective evaluation. This type of functional specialization is a hallmark of adaptation (Williams 1966).

Male PPD also appears to be associated with infant variables in the direction predicted by the defection hypothesis. Atkinson and Rickel (1984) found that, controlling for prepartum depression scores, father's postpartum depression scores were significantly negatively correlated with the perception that the infant was "better than average." Male PPD was also correlated with prepartum expectations of a better than average infant. Thus, men who, prepartum, expected their infants to be above average, but, postpartum, felt their infants to be below average were the most likely to be depressed.

Not all studies support associations with infant problems and PPD (Paykel et al. 1980), and some support an association between *less* complicated deliveries and PPD (O'Hara et al. 1982; Paykel et al. 1980). The authors of these studies suggest this could be the result of additional support from doctors and family members received by mothers with very complicated deliveries. If doctors, nurses, and other hospital staff assume most of the costs of caring for a seriously impaired infant, while they and family members also provide the mother with high levels of support, the mother's very low costs may not exceed her benefits, and she will therefore have little reason to experience PPD. These last two studies notwithstanding, there is clear evidence that both infant problems and reliable indicators of infant problems are significantly associated with PPD.

To my knowledge, poor infant temperament, usually categorized as an "infant problem" in most studies of PPD, is not an indicator of decreased infant viability. However, it is associated with increased costs to the mother—colicky babies can be exhausting. Poor infant temperament should therefore also be significantly correlated with PPD. In a meta-analysis of 17 studies on the relationship between infant temperament and PPD, Beck (1996a) found a significant positive correlation of moderate effect size.

Prediction 3: poor environments should predict negative affect. If mothers do not have sufficient resources to raise a new infant or the environment is exceptionally hazardous, they should consider defecting, saving their investment for existing or future offspring, or for their own health and welfare. Low levels of resources or a hazardous environment should therefore predict negative affect postpartum. Because it is not clear how modern environmental stressors such as poverty and crime relate to environmental stressors of ancestral environments, this article will not closely examine these variables. Nevertheless, some evidence supports the association of poverty and poor environments with PPD. Although most studies find little or no correlation of PPD with socioeconomic status (SES) or other demographic variables (Cutrona 1982; O'Hara and Zekoski 1988), this is probably because subjects are obtained from fairly homogenous middle class populations. In those few

Table 4. Cross-Cultural Studies of Postpartum Depression

Study	Ethnic groups	Sample size	Correlates and other findings
Areias et al. 1996	Oporto, Portugal	Longitudinal study of 54 women and 42 husbands	Women: reduced social support Husbands: Low social class, poor social adjustment, PPD in wife. High prevalence rates compared to similar studies in the U.S. and England.
Cox 1983	Ugandan and Scottish women	183 of 263 pregnant, rural Ugandan women were assessed postpartum	Some differences in symptom profiles between the two populations.
Ghubash and Abou-Saleh 1997	United Arab Emirates		Prepartum marital problems, postpartum marital problems, unwanted pregnancy, unwanted baby, baby's health, life events, lack of social support (e.g., housemaid), and previous psychiatric history.
Harkness 1987	Rural Kipsigis, Kenya	Sample size = 10	No PPD (probably due to low sample size).
Ifabumuyi and Akindele 1985	Northern Nigeria	Review of 50 cases of psychiatric disturbance	
Jinadu and Daramola 1990	Yoruba in Nigeria	400 prepartum, 348 postpartum	Very high rates of complaints prepartum; lower rates postpartum.
Park and Dimigen 1995	Korean immigrants to Scotland	105 Korean mothers and 52 Scottish mothers	Higher rates of PPD among the Koreans; higher rates of somatic complaints among the Koreans; equal rates of psychological complaints.
Shimizu and Kaplan 1987	Japan and the U.S.	29 Japanese; 21 Americans	Social isolation predicts PPD for Americans but not Japanese. Only traditional role concept predicts PPD for Japanese women.
Stewart and Jambunathan 1996	Hmong immigrants to the U.S.	52 Hmong women from northeastern and central Wisconsin	Symptoms look very similar to PPD, despite authors' protestations to the contrary.
Thorpe et al. 1992	Britain and Greece	65 Greek; 101 British	Lack of social support and life events both correlate with PPD.
Upadhyaya et al. 1989	Asian immigrants to England	75 Asian subjects; 75 English subjects	No difference in relative proportion of somatic vs. psychological symptoms between the two groups. Same 4 items predict case status for both groups (2 somatic; 2 psychological).
Watson and Evans 1986	Bengali immigrants to England	28 Bengali immigrants, 24 English-speaking non-Bengali immigrants, 49 indigenous English	Objective measure of PPD appears to agree with both the interviewer's subjective opinion and the mother's self-assessment for all three groups.
Yoshida et al. 1997	Japanese immigrants to England	98 mothers at 3 months postpartum	Stressful life events and obstetric difficulty but without grandmothers' support predict PPD.

PPD = postpartum depression.

studies specifically examining financially impoverished populations, rates of PPD are significantly elevated (Hobfoll et al. 1995; Seguin et al. 1995; Zelkowitz and Milet 1995).

More specifically, Warner et al. (1996) found both maternal unemployment and "head of household" unemployment to be significant risk factors for PPD. Finally, in a large study, Cooper et al. (1996) report that 7% of mothers with PPD were dissatisfied with the area they were living in (prepartum) compared to only 3% of nondepressed mothers. Thus, poor environments do appear to predict negative affect postpartum.

Prediction 4: PPD should be universal. If PPD is an adaptation, then all women in all cultural contexts should experience PPD *if circumstances warrant.* This does not imply that PPD should be found in all societies, however. If, in some particular society, all women receive sufficient social support, do not face social costs for defecting from low-viability offspring, and otherwise incur few costs when raising offspring, then rates of PPD should be extremely low. Nevertheless, if PPD is rarely encountered in non-Western populations, or if it is not correlated with low levels of social support or low infant viability, then the adaptationist account offered here is seriously undermined. *Some* women in most societies are expected to have faced the problem of insufficient social support or deciding whether to invest in low viability offspring. These problems are inevitable, and it is unlikely that most societies will have solved these problems to the complete satisfaction of all mothers.

Although studies of PPD in populations other than middle class Caucasian Americans and British are few, the syndrome has been identified in a number of different ethnic contexts (see Table 4 for a summary of cross-cultural studies of PPD). As required by the defection hypothesis, PPD does correlate with low levels of social support (Areias et al. 1996; Ghubash and Abou-Saleh 1997; Thorpe et al. 1992; Yoshida et al. 1997) and low infant viability (Ghubash and Abou-Saleh 1997; Yoshida et al. 1997). Unfortunately, studies in small, kin-based societies that are most likely to resemble ancestral social environments are essentially nonexistent.

Prediction 5: PPD is not a hormonal byproduct. Perhaps the most common preconception about PPD is that it is a maladaptive byproduct of the substantial changes in hormone levels associated with the puerperium. Although hormonal correlations with PPD would neither support nor refute the defection hypothesis, as there must be some biochemical correlates of psychological states, correlations are a prerequisite for any hormonal byproduct hypothesis. Interestingly, changes in progesterone, estrogen, prolactin, and cortisol levels appear to have surprisingly little to do with PPD (Harris 1994; O'Hara 1995). Additionally, fathers—who are not undergoing dramatic hormonal changes—experience PPD at 50% to 100% the rate of mothers (O'Hara 1985; Richman et al. 1991).

The relationship between postpartum thyroid dysfunction and PPD may support a "hormonal" etiology for a small number of cases of PPD. The results of Pop et al. (1991), as well as the work of Harris et al. (1992) and Pederson et al. (1993), clearly demonstrate that thyroid dysfunction is associated with a small but signifi-

cant fraction of PPD.[4] Nevertheless, in light of the strong associations of PPD with social support and infant variables, and its frequent occurrence in fathers, a *strictly* hormonal etiology for most cases of PPD is untenable.

Other correlates and noncorrelates. Most studies find a strong correlation between either a previous history of emotional problems, depression, or depression during pregnancy, and PPD (Atkinson and Rickel 1984; Cutrona and Troutman 1986; Gotlib et al. 1991; Graff et al. 1991; Logsdon et al. 1994; O'Hara et al. 1983, 1984; Whiffen 1988; Whiffen and Gotlib 1993). Unfortunately, the defection hypothesis does not clearly illuminate this important aspect of PPD.

Most demographic variables are not reliably associated with PPD. These include age (Campbell and Cohn 1991; Gotlib et al. 1989, 1991), marital status (Gotlib et al. 1991), occupational level (Campbell and Cohn 1991), work status (Campbell and Cohn 1991; Gotlib et al. 1989, 1991), the sex of the infant (Campbell and Cohn 1991), the number of children in the home (Gotlib et al. 1989, 1991; *cf.* O'Hara 1986), and education (Gotlib et al. 1989, 1991; *cf.* Campbell and Cohn 1991; O'Hara 1986). The expected correlations between PPD and age will be discussed later. No strong correlation is expected with marital status, as this merely represents the formal status of a mother's relationship and not the presence or absence of an investing mate. Whereas the occupational level, work status, and education of the mother might be expected to predict availability of resources and thus PPD, the relationship of these variables to resources is ambiguous at best. If the mother has a low occupational or educational level but her husband has a high occupational level, then the mother's access to resources will be sufficient. Two incomes from low occupational levels also might be sufficient. As noted earlier, financially impoverished populations do appear to experience higher levels of PPD, and maternal unemployment (as opposed to housewife status) and head-of-household unemployment have both been found to be risk factors for PPD.

Number of children in the home and sex of the infant are both potentially evolutionarily significant variables, but the data reported in existing studies do not allow tests of hypotheses regarding differential investment based on sex or number of existing offspring. The (unreported) age distribution of the existing children would be critical for evaluating the costs and benefits they represent to the mother. In ancestral environments, infants represented significantly higher costs and lower benefits (due to high rates of infant mortality) than did older children. Children of different sexes also can have different relative values to the mother when resource availability varies (Trivers and Willard 1973), and thus, in conjunction, are possible predictors of PPD, but this hypothesis cannot be assessed with existing data.

This concludes part one of the article. There is strong evidence that circumstances that would have represented increased fitness costs to mothers in ancestral environments are etiological factors for negative affect—sad or depressed mood—in modern mothers. Mother's sad or depressed mood may function analogously to

[4]Though here, too, there may be a connection with fetal strategies and lack of paternal support (see Haig 1993).

physical pain to inform her that she is suffering or has recently suffered a serious fitness cost and, as will be explained in the next section, motivate her to reduce this cost.

THE DEFECTION HYPOTHESIS, PART TWO: REDUCE COSTS

This section presents a functional hypothesis for the second major symptom of PPD: loss of interest. If a mother's sad or depressed mood informs her that she has suffered a reproductive cost, then it is possible that she will act to reduce this cost to allocate her finite resources to more beneficial ventures, consistent with PI theory. We should therefore expect mothers with PPD to frequently experience a loss of interest in the infant. Consistent with this expectation, loss of interest in the infant is a prominent symptom of PPD (APA 1994; Beck 1992, 1996b; Campbell et al. 1992). Not only do mothers with PPD often lose interest in their child, they frequently have thoughts of harming them (Jennings et al., in press). Loss of interest in the infant is not the only strategy mothers have to reduce their costs, however. Conceivably, they may decide to direct a greater proportion of their time and energy toward their infant by losing interest in other activities like caring for older children, caring for other family members, doing household chores, and working. Anecdotal evidence for this hypothesis is illustrated in an interview with a depressed mother (Beck 1996b:102):

> When I was going through the depression real bad, I pushed away my daughter and my husband. It was like I just wanted to take care of the baby and I didn't want to take care of anyone else. I could only deal with one person, and the rest of you should go away, 'cause I can't deal with the rest of it.

Beck notes that mothers in her study were unable to cope with more than one child at a time, resented their older children, and pushed them away. Because older children are more likely to survive with reduced maternal investment than are newborns, mothers with a viable offspring or an offspring with reversible health problems may opt to focus their efforts on the baby if they can count on the husband or relatives taking care of the other children. Similarly, mothers may have to reduce their investment in their husbands to focus all their effort on the newborn. Thus, when mothers have a healthy baby and a supportive mate, but also have significant and time-consuming responsibilities like caring for other young children, family members, their mate, or producing income, they may defect from these other responsibilities to invest in the newborn. Excessive noninfant-related responsibilities also may predict PPD, with loss of interest applying to activities other than infant care.

Although PPD may be an adaptation to defect from any costly activity during the puerperium, a focus on loss of interest in the infant is warranted because this symptom is likely to have the greatest detrimental effect on child development, a serious negative consequence of PPD (Murray 1992; Whiffen and Gotlib 1989).

Many women with PPD are unable to feel any joy or love in taking care of their infants, and often they have obsessional thoughts about harming them (APA 1994; Beck 1992, 1996b; Jennings et al., in press), symptoms that are clearly consistent

with a desire to defect. Similarly, "negative emotions while with the baby" are significantly correlated with PPD (Affonso and Arizmendi 1986), as are "negative or detached feelings for the baby" (Kumar and Robson 1984).

The in-depth interviews by Beck (1996b) with 12 women suffering from PPD provide a powerful portrayal of these mothers' experiences with, and attitudes toward, their infants that is entirely consistent with the defection hypothesis:

> I had no control of my own self-being, nothing, mind, soul, nothing. It [PPD] basically controlled me. I wanted to reach out to my baby, yet I couldn't (p. 100).
>
> The fact that I couldn't love her normally made the guilt even worse. You just don't feel anything good for your baby. You just feel full of guilt (p. 101).
>
> I just went through the motions making sure my baby was fed. I was just like a robot. I would pick her up. I would breastfeed her. I would put her down. I was just walking around the house like a zombie (p. 100).
>
> I would be going along and being okay, and then I would get up to that changing table and in a matter of seconds my mind would have started with, 'Oh, the baby is going to fall off the table. I don't care if she falls off the table.' Why did I think that I don't care if she falls off the table? Of course I care (p. 102).

Beck distilled nine themes from the interview transcripts, each consistent with the defection hypothesis:

Theme 1: Postpartum depression overtook mother's minds and bodies, preventing them from reaching out to their infants and depriving them of any feelings of joy.

Theme 2: Overwhelmed by the responsibilities for caring for their children, the women were petrified that they would not be able to cope.

Theme 3: To survive, some mothers erected a wall to separate themselves emotionally and physically from their children.

Theme 4: Stripped of a strong desire to interact with their children and plagued by oversensitivity to stimuli, mothers often failed to respond to their infants' cues.

Theme 5: Guilt and irrational thinking pervaded mothers' minds during their day-to-day interactions with their children. [Guilt suggests that mothers are not doing as much for their children as they feel they should; "irrational thinking" may refer to infanticidal ideation or to exaggerated fears about the infant.]

Theme 6: Uncontrollable anger erupted periodically toward the children, to the degree that mothers feared they might harm their children. [A possible infanticide adaptation.]

Theme 7: As postpartum depression engulfed the mothers, they perceived that detrimental relationships with their older children were materializing. [These mothers may be investing in the infant at the expense of their older children.]

Theme 8: Feelings of loss enveloped the mothers as they dwelled on their relationships with their children. [This theme may be most consistent with the arguments presented for negative affect in section one.]

Theme 9: Striving to minimize the negative effects of postpartum depression on their children, mothers attempted to put their children's needs above their own. [In the same way that people can continue with an activity even though it causes them physical pain, they can decide to continue an activity that causes psycho-

logical pain. This theme also suggests that mothers are "aware" of the tradeoff between investing in themselves and investing in their infants, a core concept of PI theory.]

If PPD is, in part, an adaptation to motivate women to reduce investment in their offspring under certain conditions, then women who did not want to be pregnant in the first place should be at higher risk for PPD. This is, in fact, the case. Field et al. (1985) found that an affirmative *pre*partum response to questions like "was your pregnancy unplanned?," "do you regret being pregnant?," "can you say that you do not desire to have a child?" (in addition to other questions, see Figure 1) significantly distinguished women with PPD from those without. Similarly, Campbell et al. (1992) found that not being happy about the pregnancy distinguished women with PPD from those without. Finally, Kumar and Robson (1984) found that women with PPD had significantly more often considered an abortion.

Although PPD is defined primarily by affective and cognitive symptoms, if it is an adaptation to reduce investment in offspring, then it must have, on average, actually modified ancestral mothers' behavior in a way that prevented them from attaching to or investing in their infants. The meta-analysis of Beck (1995) of 19 studies on the effects of PPD on mother-infant interactions (total number of dyads = 829) indicates that PPD has a moderate to large negative effect on maternal-infant interaction. In these studies, observers who are blind to the mothers' depression status rate her interaction with her infant. Mothers with PPD are observed to have significantly increased disengagement, negative affect, flatness of affect, irritation, tenseness, annoyance, and intrusiveness toward the infant on the one hand, and significantly less warmth, delight, positive regard, sensitivity, activity, contented facial expressions, imitative behaviors, contingent responses, and game-playing on the other. In addition to exhibiting more negative emotions and fewer positive emotions toward their infants, mothers with PPD are less responsive and less sensitive to infant cues, have failed to attain a successful maternal role, and have infants that are less securely attached (Beck 1995, 1996b; Cohn et al. 1990, 1991; Field et al. 1985; Fowles 1996; Hoffman and Drotar 1991; Murray 1991; Murray and Cooper 1996). By being less responsive and less sensitive to infant cues, mothers with PPD are clearly mothering less.

These studies indicate that mothers with PPD are ambivalent about their pregnancies, have difficulty emotionally investing in, and interacting with, their infants, and are less sensitive and responsive to their infants. These manifestations of PPD strongly support the "loss of interest" and "reduced investment" in the infant predicted by the defection hypothesis.

Whereas loss of interest in the infant has a straightforward interpretation in the context of PI theory, loss of interest in virtually all important life activities presents a more difficult although perhaps more important theoretical problem. Some possible adaptive functions for this symptom vis-à-vis evolutionarily significant risks and dangers of the puerperium will be offered in the next section. These more speculative functions extend the "defection" hypothesis to renegotiation or defection from relations with the father and family members in an attempt to solve two problems: